RIDGE AND BUILDING CONVENTION NUMBER NOVEMBER, 1939

Railway Engineering and Maintenance

BOLTED SECURITY

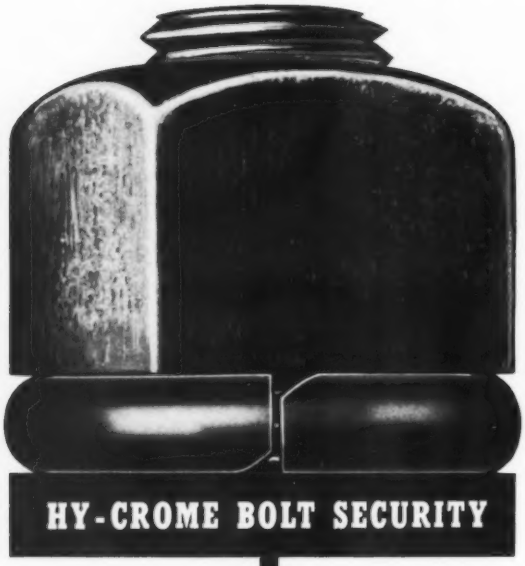
all along the Line with

IMPROVED

HIPOWER

SPRING WASHERS!

Reliance HY-CROME *Spring Washers*



Loose

ENGINE AND TRACK

BOLTS

- **POOR ASSEMBLY METHODS AND FAULTY DEVICES** often contribute to a costly and inefficient condition in bolted assemblies.
- **INEVITABLE WEAR,** resulting from frictional contact of bolted parts — impact loads — torsional stresses — climatic conditions — corrosion and scale usually are the contributing factors to looseness in bolted assemblies.
- **RELIANCE HY-CROME** Spring Washers are developed scientifically and manufactured to meet these varying demands. Sufficient tension — adequate reactive range — non-fatiguing pressure — automatic compensation for looseness — maintains the best possible condition pending maintenance periods, thus additional wear is retarded and assembly parts protected.
- **MODERN METHODS AND EQUIPMENT** enable us to produce a high quality product. Our Sales Engineers will gladly call without obligation.

EATON MANUFACTURING COMPANY

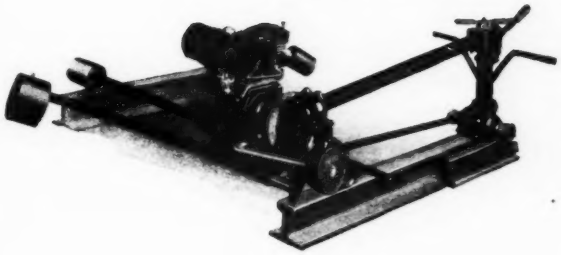
RELIANCE SPRING WASHER DIVISION

MASSILLON, OHIO

Sales Offices: New York, Cleveland, Detroit, Chicago, St. Louis, San Francisco, Montreal

Published monthly by Simmons-Boardman Publishing Corporation, 105 W. Adams St., Chicago, Ill. Subscription price: United States and Possessions, and Canada, $2.00; Foreign, $3.00. Single copies 35 cents. Entered as second-class matter January 20, 1933, at the postoffice at Chicago, Ill., under the act of March 3, 1879, with additional entry at Mount Morris, Ill., postoffice. Address communications to 105 W. Adams St., Chicago, Ill.

Raco Power Track Machine



Light, strong, easily handled.

The choice of **50 roads,** including the largest systems.

The original design of the Raco has proved so satisfactory that no major change has been necessary. Parts furnished to-day are interchangeable with all machines in service.

The Raco delivers an exactly uniform power to every nut. The slip clutch is the most reliable known means to accomplish this.

The **most mobile** machine is the **fastest** machine. On out-of-face tightening, **over the long stretches,** the Raco proves its **speed and economy.**

Raco Tie Boring Machine

Bores holes for **screw** spikes or **cut** spikes.

Bores ties in track more than **twice as fast** as any other accepted means.

Bores holes **absolutely vertical.**

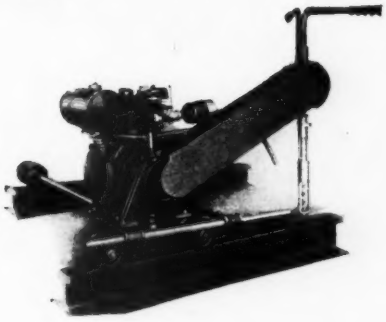
Locates all holes **exactly in center** of tie plate punching.

Automatically **controls depth** of hole.

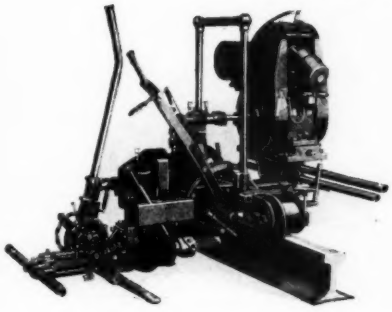
Chips are blown away as fast as made, leaving hole clear.

One-man operation.

Machine can be removed from track by one man.



Everett Power M-W Machine



For ten years the Everett M-W has been the **standard** power rail drill on practically all railroads.

Its design and construction insure the utmost in facility of operation and in speed and accuracy of adjustment.

It has made such astonishing records for economy that **no road can afford to use any other means for drilling bolt holes.**

RAILROAD ACCESSORIES CORPORATION

MAIN OFFICE

405 LEXINGTON AVENUE

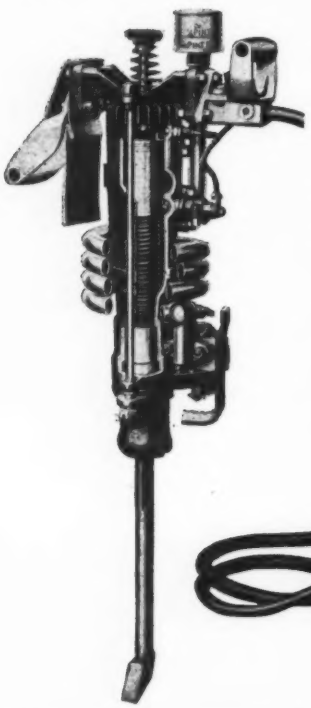
(Chrysler Building)

NEW YORK

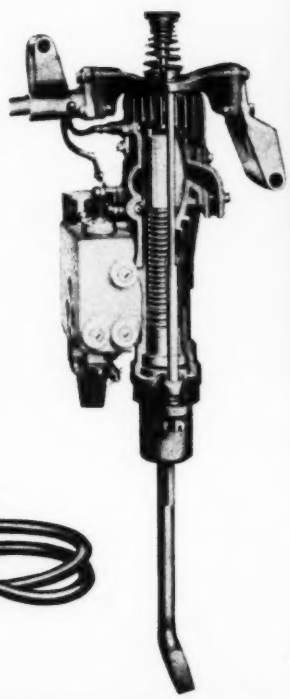
1940 BUDGETS Should Include

BARCO
UNIT TYTAMPERS

BARCO
Type K-1 Light Weight Tytamper for all types of ballast and general tamping.



BARCO
Type TT-2 Heavy Duty Tytamper, for use where a very heavy blow is desired.



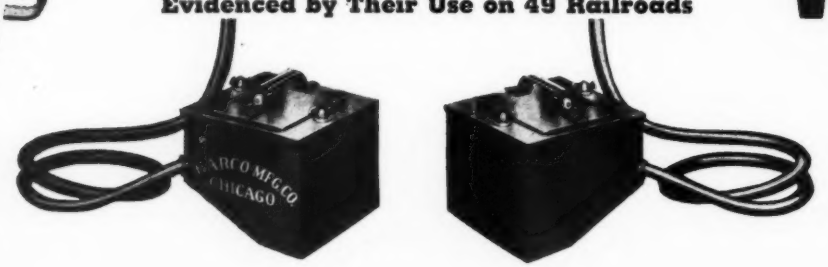
Lower Initial Capital Expense for Equipment.

Lower Operating Cost.

All Year Around Service in Gangs or in Individual Units.

Entirely Self-Contained — Carried by One Man—No Auxiliary Equipment Required.

BARCO provides the Most Flexible, Convenient and Efficient Method of Maintaining Thoroughly Tamped Tracks, as Evidenced by Their Use on 49 Railroads



BARCO MANUFACTURING COMPANY
1805 W. Winnemac Ave. Chicago, Illinois

In Canada
THE HOLDEN COMPANY, LTD.
Montreal — Moncton — Toronto — Winnipeg — Vancouver

FAIRMONT LEADS IN FEATURES THAT SERVE YOU BEST

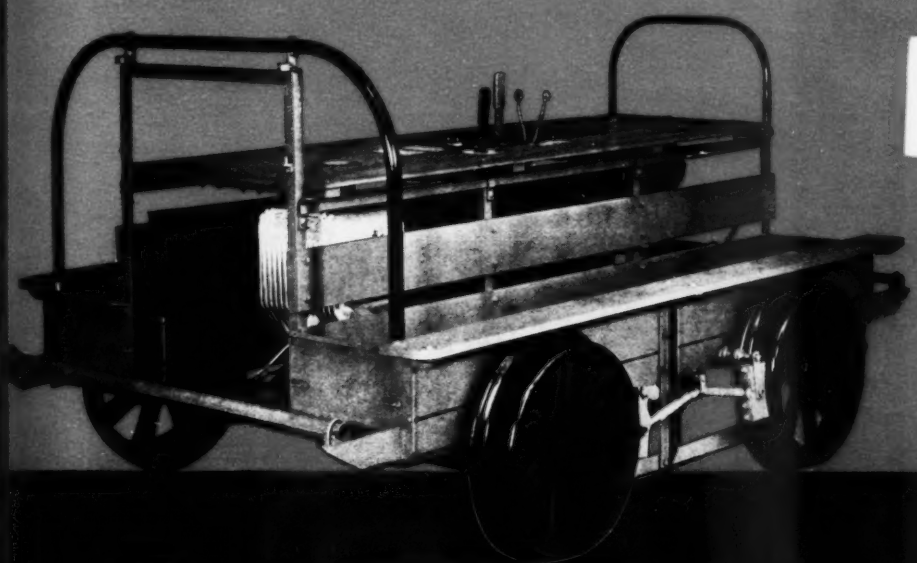
HINGED HOUSING SEAT

HOLDS 10 MEN AND TOOLS

8-13 H. P. ROLLER BEARING ENGINE

WATER - COOLED

2-SPEED TRANSMISSION OPTIONAL AT EXTRA COST



Fairmont S2 SERIES "G" CAR

Tow BIG LOADS at Low Cost

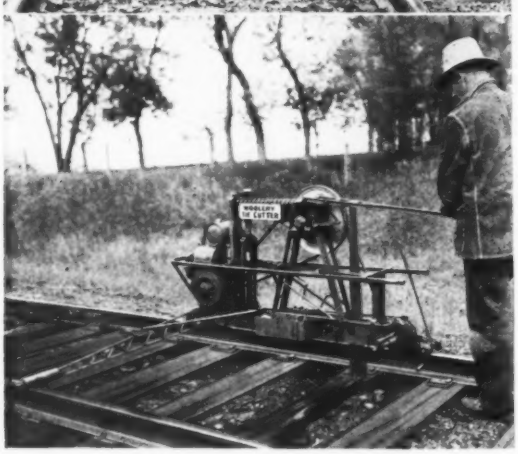
For heavy duty section service the Fairmont S2 Series G car offers many advantages. It can carry big loads—10 men and tools—and its high drawbar pull at normal speeds makes it ideal for towing trailers. The power plant—Fairmont's famous RQ roller bearing engine has a large reserve of smooth flowing power and is one of the most economical engines to maintain because of its simplified design. A 4-inch endless cord belt, driven by a 7-inch engine pulley transmits this power to the wheels. For still greater pulling ability at reduced speeds, a 5-inch or 6-inch engine pulley can be provided. The normal drawbar pull can be practically doubled in low speed by installing a Fairmont two-speed transmission. For further details on the S2 Series G write for Bulletin 386. Fairmont Railway Motors, Inc., Fairmont, Minnesota.

OF ALL THE CARS IN SERVICE TODAY

More Than Half are Fairmonts

Performance ON THE JOB COUNTS

Why Take Out a Tie the HARD WAY



Upper View: Removing an end section of tie that has been cut by the Woolery machine.
Lower View: The WOOLERY TIE CUTTER—Light in weight and easily removed from the track by its operator in 30 seconds.

When You Can *EASILY Lift It Out!*

The WOOLERY TIE CUTTER *Provides the Modern Way*

Why struggle to pull out *intact* a tie that you are going to burn when, with the Woolery machine, you can so greatly simplify its removal by taking it out in three easily-handled pieces?

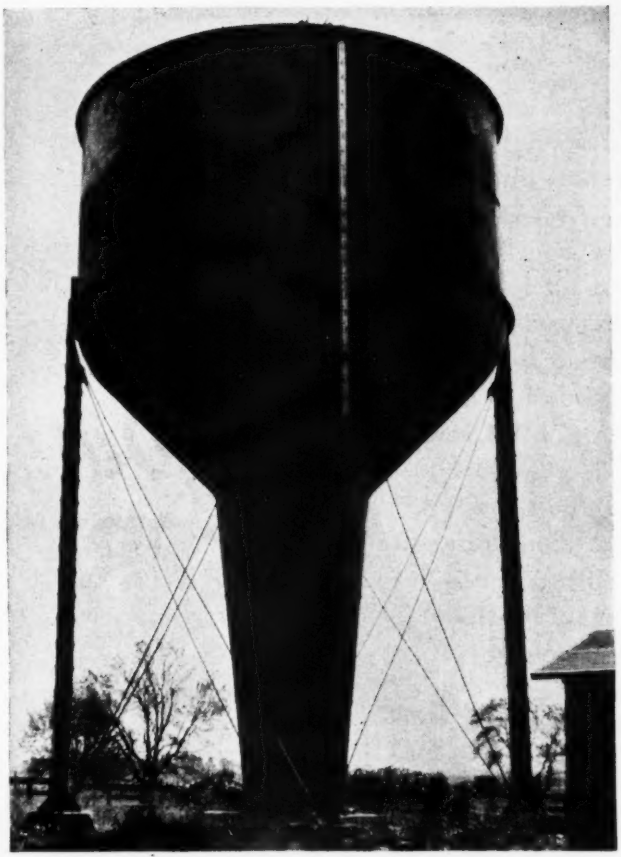
This is just one of the labor and time saving features of the Woolery method that make it possible to cut tie renewal costs 30% and so speed up the work that the renewal program can be completed weeks, or even months, ahead of schedule.

The necessity for digging out the adjacent crib is eliminated . . . the temptation to renew a tie that may have a year or more of service life is removed . . . and there is minimum disturbance of the bed, thus conserving the large investment made in the tamping of the old tie.

Be sure to include Woolery Tie Cutters in your 1940 budget . . . they will prove to be a most profitable investment for your railroad. Write for descriptive booklet.

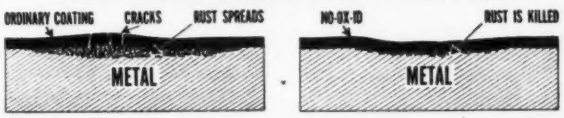
WOOLERY MACHINE COMPANY
MINNEAPOLIS — Pioneer Manufacturers of — MINNESOTA
RAILWAY MAINTENANCE EQUIPMENT
TIE CUTTERS • SWITCH HEATERS • MOTOR CARS
RAILWAY WEED BURNERS • BOLT TIGHTENERS

STOP STEEL TANK CORROSION —INSIDE AND OUTSIDE!



NO-OX-ID gives permanent protection to the surface areas and framework of wayside tanks. It stops pitting on tank interiors without contaminating the water.

NO-OX-ID PROVIDES MECHANICAL AND CHEMICAL PROTECTION



Ordinary coatings which dry by oxidation are permeable and do not keep out all moisture. Furthermore, they do not adhere to rusted areas over which they may be painted, but crack as they dry and admit moisture. As a result, corrosion progresses rapidly under the coating.

NO-OX-ID has a very high resistance to moisture penetration. When applied over rusted areas, it maintains a plastic, flexible, and bonded coating on the metal that cannot crack and admit moisture. In addition, NO-OX-ID contains chemical inhibitors that check all under-film corrosion.

Tank Interiors Can Be Reconditioned in Only 72 Hours

Here's an easy, inexpensive way to obtain permanent protection for your steel wayside water tanks —and you can return them to service in three days!

Just wire brush or scrape off the old rust scale and paint from the inside of the tank. Then rub in a coat of NO-OX-ID "A Special." Allow a day for the solvent to evaporate, and the tank is then ready for use. For the outside of the tank, clean and apply NO-OX-ID "Gloss Filler Red" as a primer if you wish to apply oil paint.

NO-OX-ID is a non-drying coating that prevents rust in two ways: (1) by the chemical action of a rust inhibitor; and (2) by the mechanical exclusion of moisture and oxygen.

Will Not Contaminate Water

NO-OX-ID leaves no odor and does not contaminate boiler or domestic water in any way. It is chemically inert.

Frameworks of tanks, as well as such equipment as water lines, valves, and fittings, can also be kept free of corrosion with NO-OX-ID.

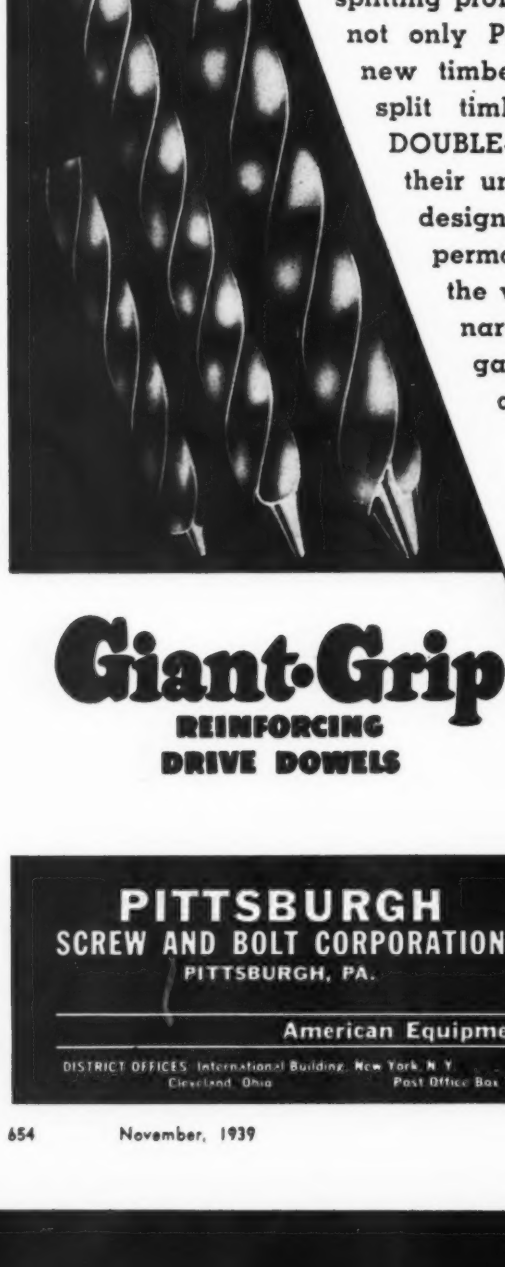
WRITE FOR DATA BOOK—Tells how to use NO-OX-ID on bridges, expansion bearings, turntables, track scales, underground pipe lines, etc.

DEARBORN CHEMICAL COMPANY
Dept. U, 310 S. Michigan Ave., Chicago, Ill.
New York • Los Angeles • Toronto

NO-OX-ID
IRON + OX = RUST
TRADE MARK
The Original Rust Preventive

2 proved-in-service PRODUCTS

THEY ALWAYS STAY PUT AND INSURE LONGER LIFE ON HEAVY TIMBER CONSTRUCTION



Adding real permanence to all timber construction, these outstanding products are a boon to every man who works and FIGURES in timber or ties. GIANT-GRIP DOWELS drive straight to the heart of the costly splitting problem in all heavy timbers, not only PREVENTING splitting in new timbers but also salvaging split timbers already in use. DOUBLE-GRIP SPIKES, with their unique double locking design, join wood timbers permanently. One does the work of three ordinary spikes. Investigate these remarkable advances —send for samples.

Giant-Grip
REINFORCING
DRIVE DOWELS

Double-Grip
Spikes

PITTSBURGH
SCREW AND BOLT CORPORATION
PITTSBURGH, PA.

GARY
SCREW AND BOLT COMPANY
GARY, IND.—CHICAGO, ILL.

American Equipment Corp. . . . . Norristown, Pa.

DISTRICT OFFICES: International Building, New York, N. Y. General Motors Building, Detroit, Michigan N. B. C. Building, Cleveland, Ohio Post Office Box 222, Savannah, Georgia Republic Bank Building, Dallas, Texas

FREE

PRODUCT INFORMATION YOU SHOULD HAVE AND NOW CAN GET

KOPPERS COAL
FOR INDUSTRIAL FUEL
HEATING · POWER PLANTS · RAILROADS · BUNKERS · SMITHYS · PROCESSING
A VARIETY OF DESIRABLE PROPERTIES.
KOPPERS AMERICAN SECTIONAL BRONZE-IRON PACKING
RESTRAINED TYPE SECTIONAL PACKING
For Locomotive Main Cylinders
APPLICATION
CONSTRUCTION
PRESSURE-TREATED LUMBER FOR RAILROAD CARS
THE LIFE EXPECTANCY OF UNTREATED AND PRESSURE TREATED CAR STOCK
RESISTANCE OF TREATED LUMBER TO WEAR
TYPES OF PRESERVATIVE TREATMENTS WHICH ARE AVAILABLE
PAINT-ABILITY OF PRESSURE-TREATED LUMBER
THE WOOD PRESERVING CORPORATION OF PENNSYLVANIA
KOPPERS

CHECK YOUR NEEDS

SEE OTHER SIDE

TEAR OUT THIS CARD

KOPPERS COMPANY, Pittsburgh, Pa.
Please send me the following product information:

- ☐ Pressure-treated Timber
- ☐ Pressure-treated timber in railroad cars
- ☐ How to measure effectiveness of pressure treatments of timber
- ☐ Typical Highway Bridges of Pressure-treated Timber
- ☐ Pressure-treated Piling
- ☐ Pressure-treated Poles
- ☐ Pressure-treated timber in company houses and buildings
- ☐ Prevention of Termite Damage to Buildings
- ☐ Painting of Creosoted Wood
- ☐ Sectional Packing for Locomotive Main Cylinders
- ☐ Sectional Packing for Locomotive Valves
- ☐ How to Order Piston Rings
- ☐ Piston Rings for Diesel Motors
- ☐ Piston Rings for Bearings
- ☐ Roofing and Waterproofing Specifications
- ☐ How to Build Steep Roofs with Coal Tar Pitch
- ☐ Spray Pond or Flooded Roofs
- ☐ Membrane Waterproofing
- ☐ Dampproofing
- ☐ Coals for Various Purposes
- ☐ Coal for Heating, Power Plants, Railroads, Bunkers, Smithies, etc.
- ☐ Stoker Coals
- ☐ Creosote
- ☐ Fast's Self-aligning Couplings
- ☐ Maintenance and Construction of Paved Surfaces
- ☐ Bituminous-base Paints and Coatings
- ☐ Front-end Paint
- ☐ Electrical Contracting Service
- ☐ Industrial Boiler Plants
- ☐ Material Handling Systems
- ☐ Wedge Wire Screens
- ☐ Carpenter Centrifugal Driers
- ☐ Coal Cleaning Systems
- ☐ Coarse and Fine Coal Launders
- ☐ Dock and Wharf Construction
- ☐ Drydocking Facilities
- ☐ Car Floats, Ferries
- ☐ Disinfectants, Insecticides
- ☐ Weed Killers
- ☐ Insulating and Jacketing Cars

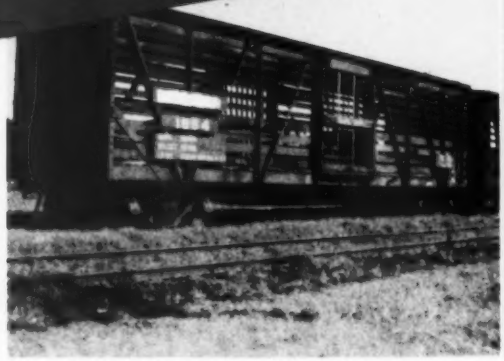
Your Name .....

Title .....

Company .....

Address .....

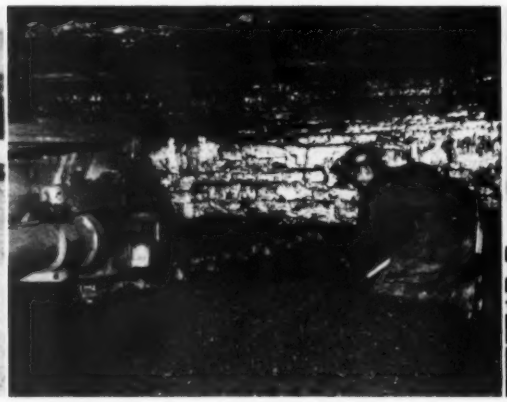
YOU CAN MAKE EXTRA PROFITS WITH KOPPERS PRODUCTS



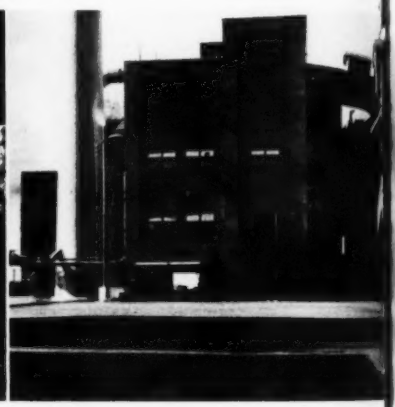
PRESSURE-TREATED RAILROAD CAR MATERIAL. This folder tells how railroads are using pressure-treated car material, how much longer life may be expected from it, what to treat, what treatments to use, etc. Send for your copy.

KOPPERS AMERICAN HAMMERED BRONZE-IRON SECTIONAL PACKING. Use the attached post card to write for your copy of the product information sheets on this bi-metallic segmental ring assembly which gives longer life for the packing, for the cylinders and for the pistons.

KOPPERS COAL TAR ROOFING. How to build every type of roof, including steep roofs, with coal tar pitch . . . why coal tar pitch gives such long years of service . . . how to insulate roofs, build flashings, etc.—all this information is contained in the Koppers Roofing Specification Book. Send for a copy.



KOPPERS COALS. The product information sheets shown on the opposite side of the post card on this page contain specific information about each of the many Koppers Coals and tell why they are so well suited to each use. Send card for your copies.



STEAM AND ELECTRICAL POWER PLANTS. Send for the two product sheets of information which tell how Koppers engineers will study your steam or electrical power needs and suggest methods of conserving power or designing plants for utmost efficiency.

Postage Will be Paid by Addressee

No Postage Stamp Necessary If Mailed in the United States

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO. 1046, SEC. 510 P. L. & R., PITTSBURGH, PA.

KOPPERS COMPANY

1105 KOPPERS BUILDING

PITTSBURGH, PENNA.

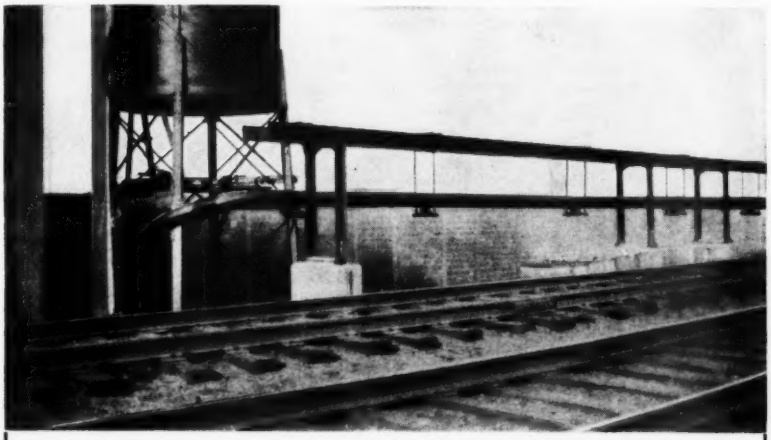
KOPPERS PRODUCTS DO A BETTER JOB FOR YOU . . . and they are backed up with a complete file of product information to help you do a better job with them. Facts. Figures. Sizes. Measurements. "How to do it" information.

Tear out this card. Turn to the reverse side. There you will find listed some of the product information folders which can help you in your work. Check off the ones you want and mail the card (no postage).

USE THIS CARD

Oxweld Railroad Service TOPICS

1912 — OVER A QUARTER CENTURY OF SERVICE TO AMERICAN RAILROADS — 1939



MANY ECONOMIES
with welded piping systems

Piping systems for all types of service—water, steam, gas, or oil—are installed at low cost by oxy-acetylene welding. Welded piping is easily insulated and offers minimum resistance to flow. Welding utilizes the full strength of the pipe and permits installation in cramped quarters or locations where space is a factor. The steam line illustrated was installed in a railroad yard over eleven years ago and is still in excellent condition—an example of the economical service obtained when piping is welded under Oxweld supervision.

AIR-ACETYLENE FLAME
aids in Building Maintenance

Air-acetylene appliances are widely used in building maintenance operations because of their instant heat and ready portability. The heavy-duty soldering iron is an effective tool in the installation and repair of gutters, leaders, and metal roofs. The air-acetylene torch is ideal for use when installing solder-type pipe fittings and for thawing frozen pipes because the flame is

confined to a small area. The paint burner provides a soft, easily controlled flame which speeds the removal of paint from wood or steel structures without damaging the base material.

• BRIEFS •

Motor Car Headlight—The Prest-O-Lite motor car headlight, weighing only 16½ pounds, is widely used as a portable light by track and bridge inspectors and water service men.

• • •

Hard-Facing Tamper Shoes—Experience has shown that the service life of tamper shoes can be increased 2 to 3 times by hard-facing a band of the wearing surface about one inch wide with Haynes Stellite alloy.

• • •

Wrinkle Bending—Wrinkle bending is a quick, low cost method of bending pipe to any desired curvature without reducing original wall thickness. As shown in the illustration, the wrinkles project outward so that full cross-sectional area is retained. Wrinkle bending is readily performed in conjunction with the installation of welded piping.

• • •

In addition to bringing to railroads the oxy-acetylene process applications described on this page, Oxweld Railroad Service provides hardening of rail ends, pressure welding of rail, rebuilding of rail ends, and Unionmelt welding. For further information on any of these operations, consult The Oxweld Railroad Service Company, Unit of Union Carbide and Carbon Corporation, Carbide and Carbon Building, Chicago and New York.

OXWELD RAILROAD SERVICE

The words "Haynes Stellite," "Oxweld," "Prest-O-Lite," and "Unionmelt" are registered trade-marks of Units of Union Carbide and Carbon Corporation

TO RAILWAY SUPPLY MANUFACTURERS

"Insurance"

"Boss, how do you like those orders I've been turning in lately? Aren't they pippins?" asked the star salesman of his railway sales manager.

"They were certainly fine, Bill. It looks like business is coming back with a bang."

"I'll say it is—and I'm only started. There's a lot more business in the making."

"If it continues to come in at this rate, we'll soon be filled to capacity. I've been thinking, maybe we had better trim our sales efforts a little."

"What do you mean, Boss?"

"To be specific, I mean that we might reduce our advertising and save that money."

"Wait a minute, Boss. Are you crazy?"

"No, I'm not. What's the use of advertising when we're getting all the business we can handle anyway."

"Don't you realize that we're getting this business because we kept our products before these railway men when they hadn't any money, with the result that when their earnings increased so suddenly they were already educated to our products and had us in mind. We're getting big returns now on *all* the advertising we've done in these last dull years."

"Possibly that's true but still I can't see why we shouldn't save some advertising money now when we're going to be turning down business in a few weeks."

"Boss, what will we do when this flood of orders levels off?"

"What do you mean?"

"I mean just this—that this spurt will slow down some time and when it does, we're going to need business again and need it badly."

"Well, what's that got to do with advertising?

"Just this, Boss, that if orders again become few and far between we'll need all the help we can get to land those that are placed."

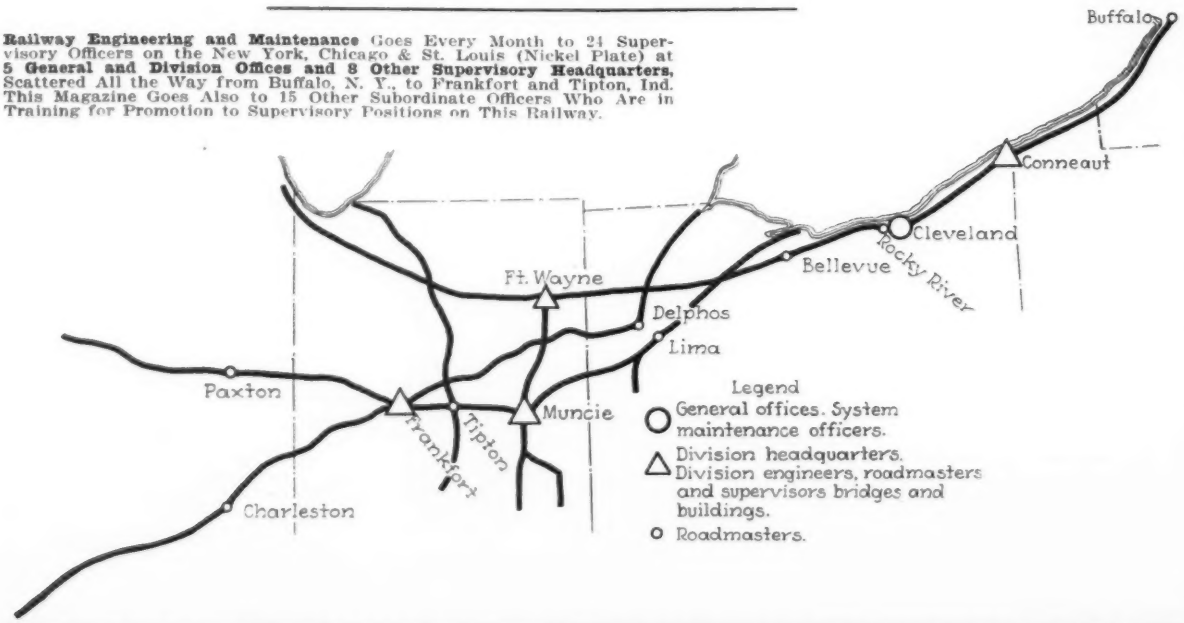
"Your thought is that we'd better keep up our advertising, even though we may have to turn down orders for a time, as a protection against those days when we'll again want business."

"That's it, Boss. We just can't afford to stop."

"I guess you're right. We'll continue our advertising as insurance against the days when business may again be hard to get."

"Boss, you'll find it'll pay."

Railway Engineering and Maintenance Goes Every Month to 24 Supervisory Officers on the New York, Chicago & St. Louis (Nickel Plate) at **5 General and Division Offices and 8 Other Supervisory Headquarters,** Scattered All the Way from Buffalo, N. Y., to Frankfort and Tipton, Ind. This Magazine Goes Also to 15 Other Subordinate Officers Who Are in Training for Promotion to Supervisory Positions on This Railway.



RAILWAY ENGINEERING AND MAINTENANCE IS READ BY MAINTENANCE OFFICERS OF ALL RANKS

COMPLETELY MECHANIZED
for faster rail laying—improved track

Nine Nordberg Power Tools are being used on this Chicago and North Western rail laying job.

This completely mechanized rail gang on the Chicago and North Western is typical of how many progressive roads lay steel. Operations which formerly were done by hand labor are now being done with Nordberg Power Tools. Complete mechanization has made faster progress possible, lessened expense and improved the quality of track work.

In six days, including time required to unload and again load the equipment after the job was completed, ten track miles were laid with 141 men. At the head of the gang Nordberg Power Wrenches removed the nuts from the track bolts. Then followed the Spike Pullers and the Adzing Machines. At the rear, Nordberg Wrenches ran up the nuts on the new rail, tightening all bolts with uniform tension.

Follow the examples set by many of the country's prominent roads and completely mechanize your rail laying gangs. Standardize on Nordberg Tools. They reduce the cost of rail laying and aid in attaining a standard of track work in keeping with the needs of present day heavy high-speed traffic.

TRACK MAINTENANCE TOOLS BUILT BY NORDBERG

Adzing Machine
Spike Puller
Power Wrench
Rail Grinder
Utility Grinder
Precision Grinder
Power Jack
Rail Drill
Track Shifter

NORDBERG MFG. CO. MILWAUKEE WISCONSIN

Export Representative—WONHAM Inc.—44 Whitehall St., New York

No. 131 of a series

Railway
Engineering and Maintenance
SIMMONS-BOARDMAN PUBLISHING CORPORATION

105 WEST ADAMS ST.
CHICAGO, ILL.

Subject: The Business Press

November 1, 1939

Dear Reader:

A news release a short time ago carried the information that 148 member publications of the Associated Business Papers, Inc., carried 106,484 pages of advertising last year, involving an expenditure for space of $18,811,446. These figures are large in themselves; they are especially significant, however, when one considers that 1938 was a year of subnormal activity in industry and in advertising.

Figures such as these give you a measure of the extent to which business papers enter into the sales plans of leading manufacturers of materials and equipment used by industry. This measure is evidenced further by the large and continued use made of these publications by many companies which, through aggressive sales policies through the years, have become outstanding institutions in their fields.

These figures measure also the service rendered you by the advertising pages, in which alert manufacturers are directing your attention to their equipment and materials and to the advantages that such equipment and materials offer you in the conduct of your work.

I am bringing these figures to your attention in the belief that they will be of interest to you. I am hoping also that they may give you a clearer appreciation of the importance of the service rendered by such publications as Railway Engineering and Maintenance.

Yours sincerely,

Elmer T. Howson

ETH:EW

Editor

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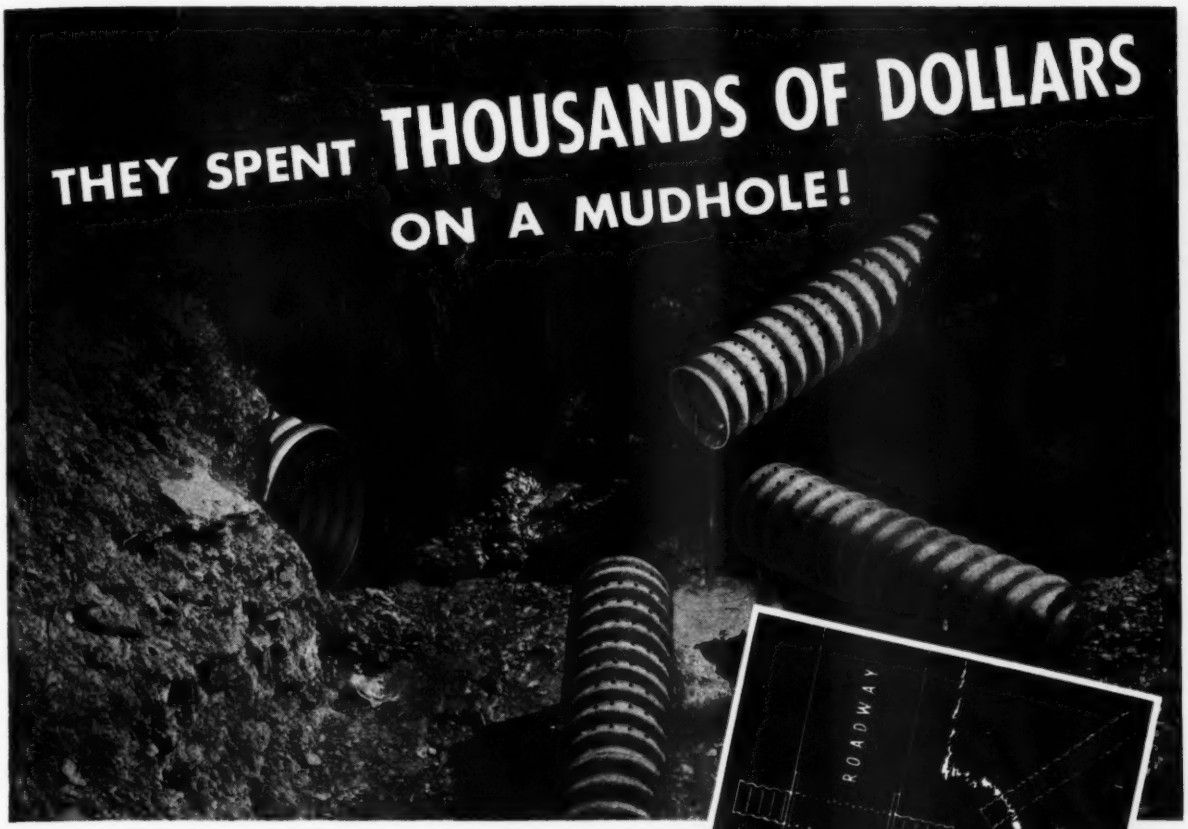
THEY SPENT THOUSANDS OF DOLLARS ON A MUDHOLE!



— then cured the SORE SPOT with Perforated Steel Culverts

THIS wet hillside was a continual source of trouble, causing a soft roadbed and intermittent slides. Thousands of dollars had been spent in repairs and maintenance work without lasting success. Then they installed three lines of U·S·S Perforated Culverts extending up the hill like a chicken foot and draining into a fourth culvert through the roadbed. This economical installation solved the drainage problem without further trouble.

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A large majority of road maintenance jobs can be traced to inadequate drainage. Many of them could be prevented if more culverts were used in the first place. The low cost of galvanized culverts of U·S·S Copper Steel makes it possible to furnish better drainage without running up the cost of the job.

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A NEW, FAST, LOW-COST WAY TO REMOVE STEEL POWER-LINE POLES FROM CONCRETE

THE Chicago Surface Lines has developed a new method of breaking the bond between steel poles and the 6 feet of concrete they are anchored in . . . turning a tough job into a simple one requiring only a few minutes.

Four hydraulic jacks and a collar, and a central hydraulic pump, are mounted on an International I-14 Tractor. The tractor is driven up to the pole, the collar opened and the jacks lowered to the ground. The collar is then locked and wedges set between it and the pole. Pressure of approximately 160 tons can be built up by the hydraulic pump, although that much pressure is rarely needed. When the bond is broken, the unit is uncoupled and the tractor quickly driven to the next pole.

The collar has been used for some time with journal jacks. Four men manned the jacks but it was impossible to apply equal pressure all around. The International Tractor has permitted the use of a central hydraulic pump and the heavier-type hydraulic jacks, and has eliminated unloading and loading of the collar and jacks at each pole. It has made a compact, mobile combination that has materially reduced costs. This is typical of the jobs International tractors are called on to do. New uses for their versatility are turning up all the time. Ask the nearby International industrial power dealer or Company-owned branch for information on their ability to solve problems for you.

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Published on the first day of each month by the

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105 West Adams Street, Chicago

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30 Church Street

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Terminal Tower

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Member of the Associated Business Papers (A.B.P.) and of the Audit Bureau of Circulations (A.B.C.)

PRINTED IN U.S.A.

Railway Engineering and Maintenance

NAME REGISTERED U. S. PATENT OFFICE

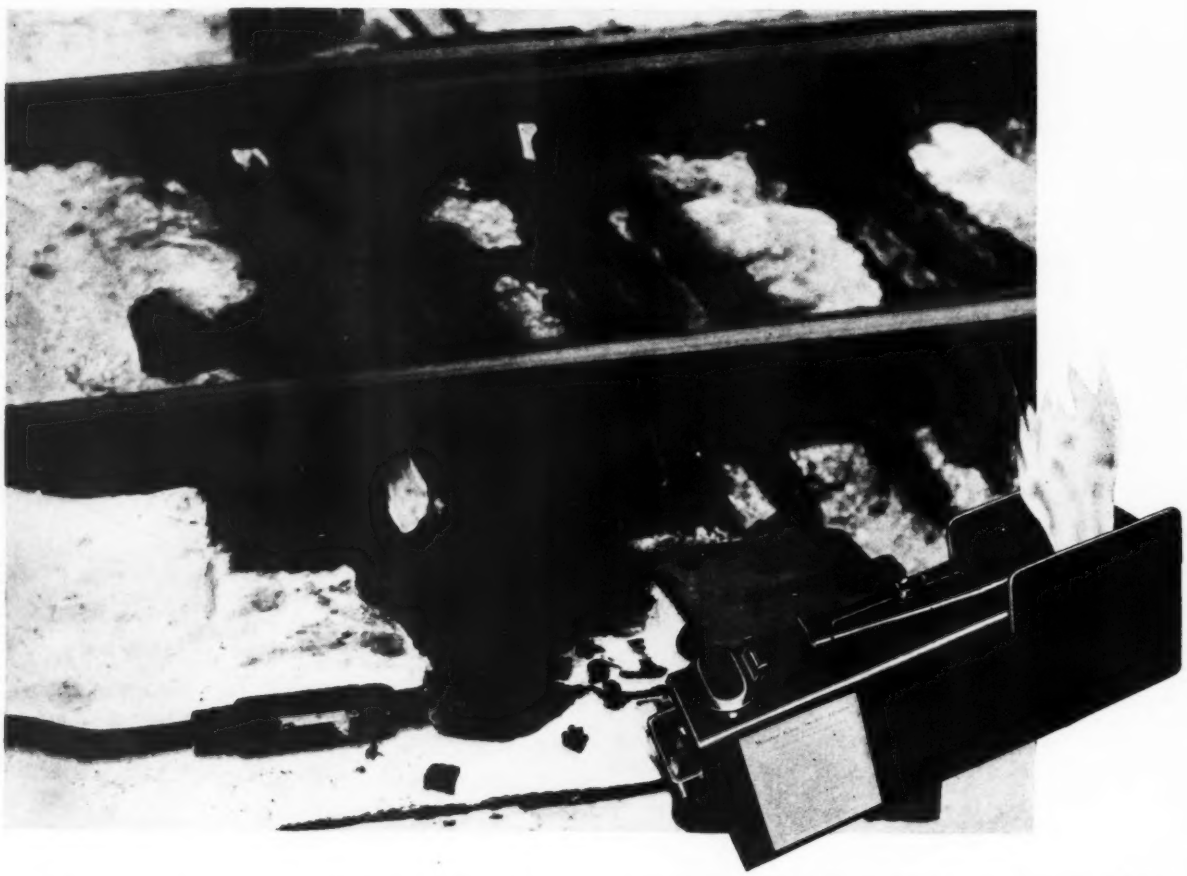
NOVEMBER, 1939

Editorial - - -

THERE'S STILL TIME

to install

Winter King Switch Heaters



Bethlehem has an ample stock of Winter King Switch Heaters, ready for immediate shipment. There is still time to install these snow melters before the worst of winter sets in—to ease your mind about yards and main lines staying open

Compared with manual sweeping and cleaning of switches, Winter Kings will save you a substantial sum. They remove snow as it falls and are equally effective in sleet storms. The difficulty and confusion of gathering a large emergency snow force is eliminated; safety is greatly increased; above all, switches *will* stay open, regardless of the length or severity of storms.

Winter Kings are low in first cost, low in fuel cost. They are easily installed. Once in place, they are ready for any storm that comes up. A few minutes will light them; a refilling every 9 to 15 hours will keep them going. In clear weather they remain in place, protected from dirt and cinders, but ready for instant use.

BETHLEHEM STEEL COMPANY

BETHLEHEM STEEL

Railway Engineering and Maintenance

Railway Employees

An Asset to a Community

WE have referred frequently in these columns to the contribution that the railway industry makes to the towns and villages, as well as to the cities, throughout this country by reason of the employment provided. Prior to 1930 more than 1,750,000 persons gained their livelihood through service on the railroads; even in these days the number exceeds 1,000,000. These employees received $2,900,000,000 in wages in 1929; last year they were paid $1,746,000,000. This money goes into every community. No other industry, except agriculture, ramifies so widely.

A Survey of Employees

Heretofore it has been difficult to discuss the distribution of these employees and their payroll in any great detail because of the lack of specific figures. Last summer, however, the research staff of the Railway Employees Department of the American Federation of Labor made a study of a specific group of railway employees that brings out some very illuminating information about the type of persons found in railway service and the nature and extent of the contribution that these people make to the communities in which they live.

This study involved employees of the mechanical and stores departments at the Cedar Lake, Minn., shops of the Minneapolis & St. Louis railway. A total of 331 persons were employed at these shops in 1938. Some 284, or 86 per cent of these employees, gave information requested in a questionnaire.

This study revealed first of all that these employees received $411,503 in wages from the railway in 1938, a very sizeable contribution to the income of any community. It showed also that the average age of these employees was 47.4 years. It was developed further that 76 per cent of them were 41 years of ago or over—or beyond the age at which it commonly becomes possible to secure employment on other railways or in large industries elsewhere. In other words, these persons were in the service of this railway to stay.

This latter fact is emphasized by the further showing that the average service of these employees with the M. & St. L. is 19 years, only 24 per cent having 10 years' seniority or less, while 59 per cent have from 11 to 20 years' seniority, and 17 per cent have more than 20 years' service. Furthermore, if service on other railways is included, 91 per cent of these employees have spent more than 10 years in railway work, confirming the fact that, more than in almost any other industry, "once a railway employee always an employee."

Home Owners

Turning to the individual family responsibility of these men, it is found that 234, or 82 per cent of them, are married and that 251, or 89 per cent, have a total of 635 dependents, an average of 2.5 dependents per employee reporting dependents. Of these dependents, 238 were children 16 years of age or under.

The survey showed also that 146, or 51 per cent, of these employees own their own homes, with a total combined valuation of $598,950, or an average valuation of $4,102 per home, a very sizeable contribution to the property holdings of any community. Furthermore, 93 of these employees reported that they owed $165,258, or an average of $1,176, on their homes, showing the necessity for their retention of their positions if payments are to be met and equities protected.

Equally interesting and enlightening is the fact that these employees paid $10,643 in real estate taxes on these properties in 1937, an average of $77.12 per home, a very definite contribution to the support of local government. This is entirely aside from such other forms of taxation as sales taxes, personal property taxes, etc.

A Real Contribution

Such is the contribution that the railway industry is making in some degree in practically every community throughout this country—a contribution that gives these communities an element of stability that is inherent in like degree in few other industries and that is found in no other agency of transportation. It is a consideration that warrants thought by every person who has the interest of these communities at heart—and not the least by the residents of these communities when they are asked to come to the assistance of competing transportation agencies that are able to survive only through subsidies derived at the expense of these communities.

This contribution to community life is made possible through railroad payrolls. It warrants emphasis by railway employees at every opportunity, in order that prop-

erty owners and taxpayers, local merchants and other citizens may be brought to a realization of the fundamental importance of the railways to the prosperity of their individual communities, not only because of the essential character of the transportation service provided but also because of the support given local business and local activities by the railroad employees.

Pumping Equipment

Present Requirements Call for Changes

WHILE the activities of the men in the water service departments of the railways have been overshadowed in recent years by the widespread publicity which has been given high-speed trains and improved train operation, and even to the developments which have taken place in track construction and maintenance to carry this faster and more dependable service, no group of railway men has faced more difficult and trying problems than those in the water service department, and no group has met its problems more effectively. In fact, many of the high-speed or shortened train schedules of today in both passenger and freight service, and especially the long runs between water and fuel stops, would not have been possible without the advances which have been made in improved boiler water and the adjustment of station facilities to meet the changed demands.

During the last few years, with the changes that have been made in train schedules on almost every road to provide faster, more effective and more economical train service, many water service men have had their work of years in carefully-developed sources of supply, pumping plants and treating, storage and delivery facilities upset almost over night. Only yesterday, so to speak, demands were being met with entire satisfaction, while today, with larger and more efficient power and with either tender tanks of larger capacity or the practice of double-tanking, hundreds of important water stations have become of secondary importance, while the demands on others have been doubled, tripled or quadrupled. At the same time, and often presenting an even greater problem, abundant sources of high-quality water have had to be by-passed and less adequate sources of less desirable water have come into greater demand.

All of this has presented large problems to water service men. Some have been solved by the construction of new facilities and others by the enlargement of existing facilities. In the latter case, in the interest of economy, hundreds of storage and treating plants have been dismantled, moved and re-erected, and both pumping and delivery facilities have been enlarged. At the same time, the opportunity has been taken in many cases to modernize equipment, to insure both the most dependable sources of supply and the most economical pumping costs.

In spite of all that has been done by water service men to meet the water requirements of present-day operation, their problems are still many and varied, and promise to continue in many cases to be more intensified than in the past as further readjustments are made in train service to speed up operation, and the demand continues for still better locomotive performance and still further reductions in water station costs. That this is true is evidenced by the fact that a committee of the American Railway Bridge and Building Association was assigned to study these particular problems during the last year, calling for special attention to the most effective and economical pumping equipment to meet today's requirements. The report of this committee is presented elsewhere in these pages and should be given most careful consideration by all water service men. It should stimulate them not only to a closer and more careful analysis of the pumping requirements of those plants of theirs upon which largely increased demands are being made by changes in operating conditions, but also of the pumping requirements of the many other plants on their roads which, although of secondary importance, may be costly in operation through the retention of worn-out or manually-operated equipment which is poorly adapted to present limited requirements. It should also stimulate them to point out to their superior officers at every opportunity, those unnecessary continuing leaks in pumping station operating costs which, in many instances, can be stopped through the installation of modern, automatically-operated and controlled equipment.

Treated Timber

Demands Close Supervision in Handling

TIMBER is treated for one purpose and one only—to protect it from the ravages of decay-producing organisms or insect attack. As is known almost universally, the protective value of the preservative treatment lies primarily in a relative thin shell or zone of treated wood, that is effective only so long as it remains intact. For this reason, it is disturbing to see the manner in which treated timber is sometimes handled before it is installed in the structure for which it is intended.

No one disputes that to insure the maximum benefit from the preservative treatment, all timbers should be framed and bored before they go into the retorts to insure that this shell will remain unbroken, and on many roads considerable effort is expended and close supervision exercised to insure that the framing is done correctly and that the treatment is to the desired standard. The astonishing thing about the matter is that when the timbers leave the treating plant, supervision over them often ceases entirely, and they are placed at the mercy of men who do not fully realize the importance of maintaining the treated zone without a break.

It is well known that some roads have gone to some length to educate their bridge and building forces in the handling of treated timbers; observation indicates that some others have paid little attention to this most important matter. Treated timbers, or untreated ones for that matter, should never be struck with a maul or sledge, or dropped or thrown about in such manner that they will be bruised, for bruised spots eventually become foci for decay. Likewise, sharp-edged or pointed tools should never be used on them as they will penetrate the zone of most thorough treatment and open a pathway for the entrance of wood-destroying organisms, which will cause early decay.

In brief, every action that will bruise or cut the wood fibre or scar the surface of the treated timber should be avoided, since experience has shown that these forms of damage invariably shorten the life of the timber. This is so important that rules for the handling of treated timber should be prepared and put in the hands of every foreman whose duties require him to handle such timbers. These rules should be explicit that the zone of treated wood shall never be broken, and responsible officers should know that they are enforced.

The Transverse Fissure

Still a Threat in Miles of Track

IT should be a source of great satisfaction to those responsible for the safe condition of railway track that the days of the most troublesome and dangerous defect ever encountered in rails—the transverse fissure—seem to be numbered. As the result of one of the most concerted attacks ever made by the railways on one of their problems, at least in the field of roadway and track, carried out in conjunction with the rail manufacturers and assisted by the research personnel and facilities of one of the country's leading universities, the origin of the transverse fissure—the shatter crack—has been determined and, of still greater importance, commercial processes of thermal treatment have been developed wherein rails can be produced that are free from shatter cracks. These facts were pointed out in an address by C. B. Bronson, inspecting engineer, New York Central System, before the Roadmasters' Association in Chicago, in September, which address is presented in this issue.

Interesting and pleasing as these developments are to maintenance of way men, who have long lived in dread of the serious potential consequences of transverse fissures, it is not to be assumed that the problems presented by these hidden defects are yet a thing of the past, or that they can be dismissed from mind for many years in the future. To impress this thought upon his listeners, Mr. Bronson pointed out that on the basis of the present rate of rail purchases, it will require approximately 20 years to replace even those rails in important main lines which were manufactured without the benefit of shatter-crack preventative treatment. He also pointed out that even if it could be assumed that all rails treated in the future will be immune from the development of transverse fissures, which is by no means a certainty, there are many other types of rail failures which are little, if any, affected by these special thermal treatments.

These facts should not be a source of discouragement. Outstanding progress has been made already in the manufacture of rails free from serious potential defects and it is only fair to assume that further progress will be made in the future. It is clear, however, that under the greater punishment that rails are receiving today through longer service life, higher speeds and heavier axle loads, the development of transverse fissures will continue and may even show a tendency to increase for a time.

With such a situation in prospect, it is no time to relax the vigilance with which fissures have been searched out in the past. On the contrary, every precaution should be taken to discover these defects before they become of dangerous size, and all employees working on the track should continue their watchfulness, with the same vigilance that has characterized their efforts in the past.

Short Line Kinks

What Are the Causes, What the Remedy?

IT is common belief among trackmen that short line kinks are much more common in stone ballast than in any other kind of ballast. Some experienced trackmen go so far as to say that this particular type of kink is confined exclusively to stone ballast, while others maintain that the kind of ballast has nothing to do with the trouble which, they say, may occur in any kind of ballast where the volume and the speed of traffic are comparable.

Extended observation will disclose that while line kinks are not confined to any particular kind of ballast, any more than other track defects are, they do occur more frequently in stone ballast, and that they are distinctive in character. In an attempt to explain them, some have expressed the belief that they result from center-bound track; others have attributed them to churning track, weak ballast shoulders and tight rail. That these are not the basic causes is attested by the fact that many of the kinks occur where none of these conditions exist. Furthermore, all attempts to segregate the ballast from all of the other factors that affect line, so that one can say that a particular kind of ballast is at fault, have failed.

Peculiarly, it has been noted that they are as likely to occur in well-maintained track as in track that is not so well maintained. In fact, some maintenance officers believe that, paradoxical as it may seem, they are more likely to do so. It has been noted also that they occur less frequently where there is a good ballast shoulder and scarcely at all in track that has been lifted from its old bed and given a general surface.

This seems to offer the explanation for the puzzling phenomenon, for it is recognized that it is impossible to maintain a good surface and uniform bearing permanently in stone ballast by continued spot surfacing. Admittedly good track can be maintained for several years, the period depending on the volume of traffic, after the track has been given a raise, but this cannot be done indefinitely. The track eventually becomes dead, and cannot be made to ride smoothly until it is again lifted.

Before this point has been reached, however, the line kinks begin to appear and serve as a warning that the time has come to give the track a light lift, for no means has yet been discovered by which they can be eliminated, except to give the track a light lift and a general surface. Lining does little good, because in most cases the track will slip back into its original position with the passage of the first train. During the present decade, general surfacing has been deferred on many miles of track that has needed this form of treatment badly, much to the detriment of the riding qualities of the track and the life of the rail. In view of the higher speeds that are demanded today of practically all passenger trains, and despite reduced earnings, railway management can well afford to return to the former cycle of general surfacing.

Where Are We Heading In

Rail Manufacture and Maintenance?*

By C. B. BRONSON

Inspecting Engineer,
New York Central System, New York

Improved Methods of Rail Manufacture and Inspection Are Eliminating the Most Troublesome Defect Ever Encountered in Rails—the Transverse Fissure

The trends in the manufacture and treatment of high-quality rail, and the means of safeguarding it in track by testing with fissure detector cars, by greater care and refinement in rail laying practices, and by welding and grinding work, are reviewed in this paper, presented by Mr. Bronson at the Roadmasters' Convention in Chicago

THE outstanding achievement in rail manufacture since the transition from Bessemer to open hearth steel is the thermal treatment of rails. This includes the processes known as controlled cooling and Brunorizing. Controlled cooling is the gradual reduction of the rail temperature in closed boxes or containers over a period of 15 or more hours, from approximately 800 deg. F. to 300 deg. F. or below, which prevents internal shattering of the metal in the rail heads. The container is either an insulated steel car with a cover, or a sheet metal box with a replaceable top to prevent the usual sudden drop in temperature. Numerous studies prove conclusively that by this method troublesome shattering can be almost, if not entirely, avoided.

Brunorizing is far more spectacular, as elaborate and costly equipment is essential. The process involves reducing the temperature of the rail in the usual way to approximately 900 deg. F., and then the gradual reheating of it in a furnace under accurate and uniform temperature control until a temperature of 1,500 deg. F. is reached; the rails then being held at this temperature a sufficient length of time to insure uniformity of temperature throughout, following which they are removed to the hot bed and allowed to cool in the regular manner. The significance of these processes lies in the fact that a commercial solution is now available and in effective use for eliminating the most troublesome defect ever encountered in rails, namely, the transverse fissure.

While great hopes and expectations may be held out for thermally-treated rails, one must not be led astray in the belief that the treatment is an effective cure-all. Either process has little, if any, effect on such old-time failures as crushed and split heads, base breaks and splits in the webs and through bolt holes. Furthermore, there is no certainty that all rails treated will be totally immune from fissure development, or that other influences may not have some bearing. Nevertheless, the methods should have a decided effect in greatly reducing the number of fissures, if not bringing about their complete elimination.

As investigations continue, light is being shed on certain minor corrections which are essential to improve the processes. Rails in the containers are not all cooled at the same rate. The temperature of those in the center of the box, on which specifications were based, are not representative of those at the bottom and outside portions of the box. Insulation of the box will probably correct this and is now under consideration. Likewise, in the Brunorizing process, certain minor changes in practice have been found advantageous.

Let me caution that the occurrence of fissures will remain unabated for several years. Rail purchases at the present rate will require 20 years to replace even the rails in important main lines. Increases in purchases will naturally decrease the length of the period of replacement, but at best, it is certain that a number of years will be required before substantial beneficial effect will be felt.

No Cause for Alarm

I do not share the alarmist's attitude that the fissure problem is becoming increasingly serious, even in the face of the fact that the number of fissures found has increased considerably during the last few years. There are reasons for this increase in the number of fissures being found. The first is the increasing number of detector units in service, and the added mileage which is being tested. The second is the improvements which have been made in the detector apparatus. But of still greater importance is the skill of the operators in handling the equipment and in interpreting the tape records. Another reason is the concentration of effort on certain locations or lines where fissures have occurred in number far above the average, and still another reason is the increased punishment to which rails are now being subjected, due to their longer life and greatly increased train speeds.

*Presented before the convention of the Roadmasters and Maintenance of Way Association in Chicago, on September 20.

The majority of the fissures detected are less than 30 per cent of the head area in size. This means that testing is done today with sufficient frequency to weed out fissures in their early stages of growth. One disquieting factor, however, is the number of fully-developed or broken-out fissures that are missed. While the number is not large, these large fissures are far more important than those of smaller area.

Another feature of the transverse fissure problem is the high percentage detected where only one occurs in a rail length. Multiple fissures are the serious type, and, fortunately, are by far in the minority. The single type in a rail length is equivalent to any other single fractured rail, such as those originating from base breaks, and are not as serious as certain types of vertical split heads, which break into many pieces if neglected. There is no justification for such rails remaining in service as advance warning is given by the widening of the head, a dark streak down the center, or cracking out in the fillet, or a rust streak at the point of failure.

Other Improvements

The manufacturers have accepted their increased responsibility to the railroads and the traveling public in providing rails to meet present-day requirements. Progressive steps in manufacture have been instituted, the first of which is the placing of the control and the responsibility for the quality of rail steel under the metallurgical department at several plants, instead of relying entirely upon the judgment of the operators who are somewhat more concerned with tonnage production. Furthermore, the responsibility for the finished product now rests with the inspection department.

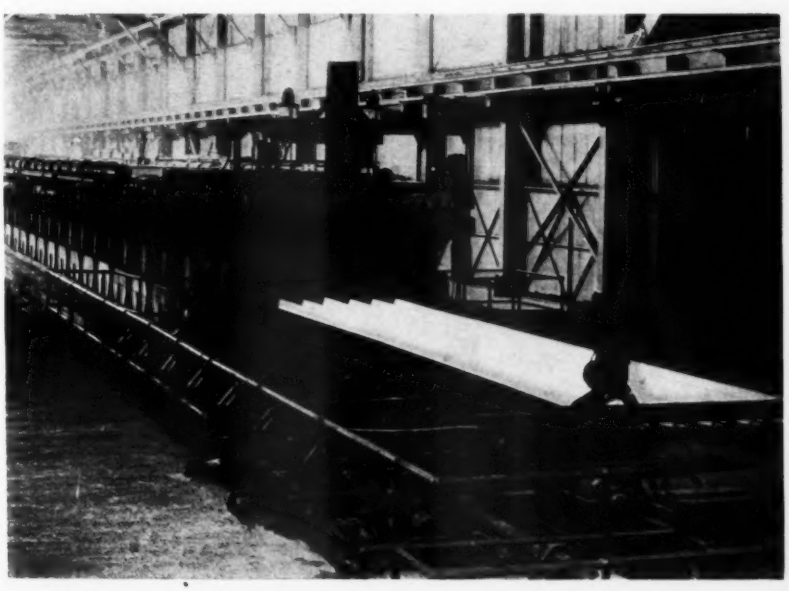
A radical change has developed in steel making in the elimination of recarburizing. The old practice was to burn out or reduce the carbon to 0.15, or even lower, and then, about one-half hour before tapping, to add molten iron to restore the carbon to the approximate average analysis of the specification. The improved practice "catches" the carbon near the specified top limit and then, by skillful maneuvering as the carbon drops to the specified range, to tap the metal from the furnace. This is possible through a very ingenious device known as a Carbometer, which permits the melter to obtain an almost instant knowledge of the carbon content of the bath. The melter, or assistant, hands a slender round bar to a laboratory representative on the open hearth floor who quickly checks the specimen and reports the carbon immediately, and with uncanny accuracy. You can readily appreciate what this means towards positive control of the heat in the furnace. Furthermore, the spread in carbon is lessened from one heat to another, insuring greater uniformity of composition. At one plant using this method, 85 per cent of the heats were within a seven-point range, and at another, 82 per cent were within a seven-point range for the shipments to us for two years. This improvement is further substantiated by the drop test results, as not a single heat was lost, and only four heats in the rollings of the last six years of one plant for our system had "A" rail rejections.

Constant temperature checks are made by the metallurgical department, not only of the pouring, or tapping, but also of the ingots and of the rolling of the blooms and rails and their finishing temperature. Unavoidable delays may and do occur to upset the normal and desired routine, but the newer methods are a long step in advance over the haphazard methods which one must admit occurred to some extent in the past.

The condition of molds in which ingots are cast is under closer scrutiny today. This may seem unimportant, but good steel cannot be made if the molds are dirty, badly checked on the inner surface, or are in generally poor condition as these conditions affect the castings or the ultimate smoothness of the finished rail. The plant inspection department also checks closely such details as rail length and the squareness of the ends, which are of considerable concern to you in a practical way. Many may doubt this because of variations observed in laying rail, but do not overlook the fact that tolerances of 7/16 in. over and under standard length are permissible, together with 1/32 in. off square at the ends. To hold within the latter limit on rails 6½ to 7 in. high makes it necessary for the mills to end-face part of their output, even though saws and blocks may be changed frequently.

Refinements Retard Production

Rail output, as indicated by the foregoing, has become an increasingly complicated affair. The universal use of thermal treatment is one complication, as rails so treated do not appear in the finishing department until 24 to 36 hours after rolling, and require rehandling, in some cases against the normal flow of the rails from the mill. End hardening, the all-ingot nick and break test, and the milling and chamfering of the rail ends add to the complexity and slowing up of normal output as compared with the past. In this connection, a note of warning is in order that piled-up abnormal demands for rail shipments in the spring cannot be met, and that a greater spread in deliveries



The Controlled-Cooling and Brunorizing Processes Employed in the Manufacture of Rails Have Had a Decided Effect in Reducing Transverse Fissures—The Photograph at the Right Shows a Charge of Rails Emerging from a Brunorizing Furnace

will be necessary, especially if larger rail programs should develop. Late deliveries for many roads will occur if the demand is wedged into a few months just ahead of the usual rail-laying season.

Rumors are heard that the present standard length of rails is about to be changed. There is divided opinion on what the new length should be, varying from the present standard to 100 ft. or more. Nothing can be done until a new standard length is agreed upon, as the mills will be compelled to institute important changes in their equipment and plant layout. Besides the question of handling, certain inevitable changes in practice must be provided for, such as even greater variation from standard length, an additional percentage of short lengths, a higher percentage of seconds, and changes in handling the "A" and "X" rail situation. Likewise, the present crude method of gagging to straighten rails is involved, as the difficulty of straightening rails will be increased.

End Hardening Considered

Greater demands are now made for the primary end hardening of rails at the mills, instead of in the field, which adds materially to the confusion of making shipments. End hardening of a normal output of rail is a considerable task, even with three working shifts a day, without seriously blocking the loading platforms and delaying shipments. End hardening at the mill has its advantages over field work, principally because in the case of the latter, the hardening lags behind rail laying, and in the interim, batter commences on the soft decarburized top of the rail head. Studies also indicate less spread in hardness in the case of mill-hardened rail ends.

Several crude forms of end hardening, which for rail steel is serious, would not be tolerated in the commercial production of heat-treated parts, such as those used in the automotive industry. The fact cannot be overlooked, however, that careful studies have shown some surprising and unexpected results, such as increased toughness and strength for most types of end hardening—a condition which holds over a wide range of temperature, comparable to summer and winter conditions. Only time will tell whether this method of prolonging rail life is entirely satisfactory, a fact that some insist has already been demonstrated.

Consideration should be given to the hardening of the receiving ends of rails only on lines with one-way traffic, as little batter is now noted on the leaving ends. No difficulty is involved in identifying the hardened and unhardened ends for correct service installation. Surface grinding is inevitable on end-hardened rails at some future date, dependent upon the volume of traffic carried, and if delayed too long, secondary batter will develop beyond the hardened zone. Surface contours lengthwise of the rail ends, enlarged ten to one, show the development of a hump on the leaving end and how it accelerates the batter on the receiving end.

Continuous Welding

Continuous welded rail is also a live subject, about which much information is now available. A wide difference in basic data has developed as the result of the several methods practiced, and one cannot deny that the special studies made have shown that some types are inferior in physical strength and solidity, with lower fatigue resistance or carrying capacity. Individual judgment will, of course, determine, based on local characteristics and traffic, where each type or method of welding might be permissible. Some processes have been greatly improved, although welds here or there may be faulty in spite of precautions taken.

Several interesting problems originated with the installation of continuous welded rail, one of which was how to offset expansion or contraction with temperature changes. Many types of rigid clips or fastenings have been developed in the attempt to anchor rails. Even previous to the welding of joints, certain track structures had been developed to make rails act integral with the ties. As the result of careful studies of the stress distribution along the length of continuous welded rails, questions have arisen as to whether all of this anchorage is essential. Furthermore, it is still an open question whether the transferring of the movement from between the rail and the tie plate to between the tie and the ballast bed is desirable, and whether this disturbance will increase the amount of tie tamping to hold proper surface.

Quality Rail Laying Essential

Modern mechanical methods of laying rail have speeded up rail laying to a considerable extent. The boast is often heard that a relatively large amount of rail or track was laid per day. This is all very desirable, but the question may be asked, whether this was done at any sacrifice in the quality of the work? No one questions the desirability of laying as much rail per day as possible, but do not overlook quality work.

A lot is heard these days about cocked bars. Some believe this does not occur on their road, but close study may show that many bars are in this condition, especially those of the toeless type, as the result of being hastily and carelessly applied. Visual examination of the bars at the toe in relationship to the rail flanges is not convincing proof that cocking does not exist. Suspected joints, or even those assumed to be in vertical alinement, should be taken apart to examine the top and bottom contacts, and should also be checked with calipers at the toe and head reinforcement. Even a small amount of cocking is undesirable as contact is thereby restricted to small areas, with consequent high pressures and possible frozen joint conditions. This, coupled with extreme tightness of the bolts, may lead to cracks in the areas of high concentrated bearing, which are sometimes charged erroneously against the quality of the material. A positive method to control the tipping-in tendency of joint bars is in use successfully on one road. This involves a wedge or spacer set back of the heads of the bars during assembly.

Power wrenches are gradually coming into more general use as they are time savers and a potential means for securing greater uniformity in fit from one joint to another. However, studies made by several sources show a rather wide variation in the amount of tension which they produce. While this is chargeable in part to variable conditions within the entire joint assembly, particularly the fit of the bolts, the excess power in these wrenches requires judicious handling. Reliance in checking bolt tightness is placed largely in the occasional use of a hand wrench, or the so-called calibrated spring. Greater accuracy is required in determining the working fit of bars and roads are urged to use an extensometer.

We hear much about methods and records in laying rails rapidly, but it is insisted that these records should not be made at a sacrifice in the uniform initial lining and gaging of the track. The haphazard placing of rails today to be straightened up tomorrow is not good practice. Tomorrow is often not the succeeding calendar day, but weeks away, and in the meantime serious damage to the rail develops which is difficult, if not impossible, to correct.

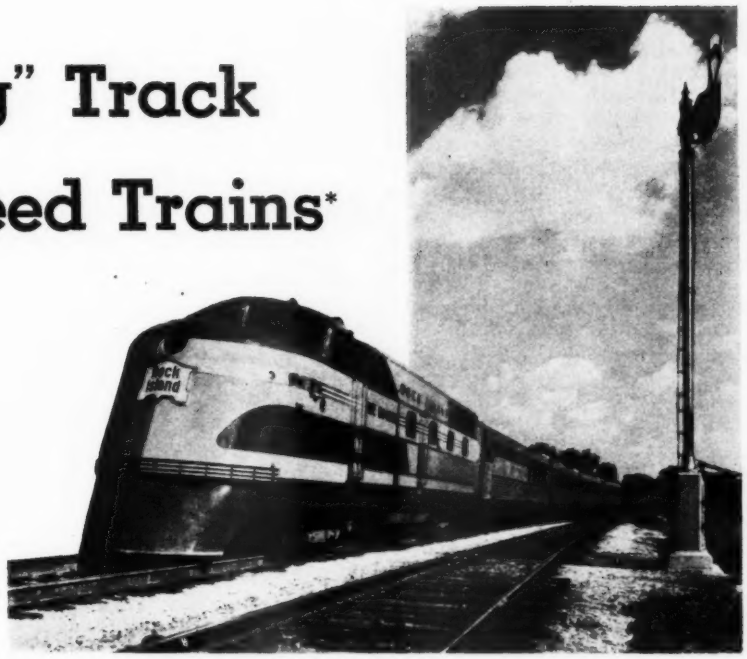
Some agitation has been started to increase the carbon content of controlled-cooled rails on the false premise that flow is due to softness resulting from the treatment. The writer knows from numerous checks on many roads that this contention is without foundation, and is more likely

(Continued on page 674)

"Streamlining" Track For High-Speed Trains*

By W. H. HILLIS

Assistant Chief Operating Officer, Chicago, Rock Island & Pacific



High-Speed Trains Require Greater Refinement in All Phases of Track Maintenance

In this paper, presented before the Roadmasters' Convention at Chicago on September 20, Mr. Hillis reviews the important considerations in maintaining track for high-speed traffic and predicts higher speeds necessitating greater refinements in track maintenance in the future

SINCE the advent of the automobile, great strides have been made in developing a highway transportation system which in some ways is more flexible than the railroads. With the vast expenditures which have been made by the Federal government, states and counties, a system of highways has been built between industrial centers, to the point where it is now possible to make over-night door-to-door delivery by truck within a radius of 300 to 400 miles.

As the result of this change in the transportation set-up of the country, the railways have had to increase the speeds of their passenger trains to 90 to 100 m.p.h., and of their freight trains to between 60 and 65 m.p.h. Such speeds were unknown even as recently as 8 to 10 years ago, with the exception perhaps of test runs which had been made at various times, during which such speeds were attained for short distances only.

The demand for increased speeds today has placed increased responsibility on roadmasters to maintain a track structure over which trains can be operated at such speeds safely, comfortably and efficiently. The question which confronts the maintenance man of the railroads today, is how this can best be accomplished and how the work can be done most efficiently and economically.

*Presented before the convention of the Roadmasters and Maintenance of Way Association in Chicago, on September 20.

Adequate Drainage Vital

There are many necessary factors in proper track maintenance. One of the most essential items is adequate drainage. It is generally conceded that if moisture is permitted to accumulate, it results in soft roadbed conditions. The track structure cannot be supported properly where conditions of this kind exist. Considerable improvement can be effected with proper surface ditches in cuts, so constructed as to intercept the water before it has had an opportunity to reach the roadbed.

It is important that side ditches be cleaned frequently to permit the quick run-off of water. If this is not done, water will accumulate in the ballast where it will cause soft spots and, in some cases, penetrate through the ballast and out onto the fills where it is likely to cause slides. It is also important that adequate drainage be provided around road crossings, particularly in the northern part of the country, to prevent heaving during the winter. Heaving at crossings has caused considerable concern and has frequently necessitated the placing of slow orders to permit comfortable riding conditions. Road crossings that heave are slow to return to a normal condition, and frequently remain in a bad condition throughout the early spring months, even after the balance of the roadbed has become normal.

The corrective measures which have been used to overcome poor drainage include the operation of spreader-ditchers, the tiling of cuts, the driving of poles in the roadbed to support the track structure, and, in some cases, the construction of concrete slabs to provide support for the ballast section. All of these methods are effective. However, the method to be selected should be governed largely by local conditions.

Good Track Materials Necessary

Essential to good track maintenance, of course, are good ballast, ties and rail. Research and tests have been conducted for many years to permit the development of the most effective and economical materials for use in track construction and maintenance. These have resulted in treated ties; the normalizing, slow-cooling and heat treating of rail; double-shoulder tie plates, etc. The changing of worn angle bars, rail-end welding and rail-end hardening, the proper tightening of bolts, etc., are also important. When tightening bolts, it is considered good practice to tighten the center bolts first to permit uniform bearing

throughout the length of the angle bar, and also to prevent its becoming cocked. When changing bars, the rail-ends should be well oiled to prevent, so far as possible, frozen joints, which are detrimental to the maintenance of proper expansion. Such measures will not only improve the riding condition of the track, but will materially increase the ultimate life of the rail.

Make Tie Renewals Early

Tie renewals should be made during the early spring months, and should be completed by June 1 if practicable, except where surfacing work is programmed, in which case the ties should be renewed in connection with the surfacing. Ties can be renewed during the early spring months more economically and with less disturbance of the track structure than later in the season. Furthermore, the renewal of ties at this time stabilizes the track structure at a period when the track is more or less unsettled. Immediately behind renewals, the track should be smoothed up to correct any irregularities which may develop.

Many Roads Favor the Use of Specialized Gangs for Heavy Track Maintenance Work

Tie Spacing Important

It is important that the ties be equally spaced in order to distribute the wheel loads over the ballast section uniformly, and it is also important that good gage be maintained, together with good line and proper superelevation on curves. Correcting these can best be accomplished at the time the track is being surfaced out-of-face.

Anchorage of the rail is equally essential to maintaining proper track conditions and is a problem to which you must give considerable study. Rail creepage develops from various causes, such as soft roadbed; the excessive braking of trains at water, oil and coaling stations; grades; climatic conditions; the density and direction of traffic; frozen joints, etc. It is impossible to prescribe set rules for the number of anchors and how they should be applied to prevent rail creepage. It is not unusual to find one rail creeping in one direction while the other rail moves in the opposite direction. Such conditions are difficult to control and require considerable study to overcome.

Special consideration should be given to anchoring track approaching bridges, turnouts and interlocking plants. Track must be anchored properly to maintain good alinement. If creepage occurs, it will result in poor line and gage, and, if permitted to continue, will cause general disturbance of the roadbed. Frequently it is necessary to adjust the number of anchors to the requirements of the particular territory or the special conditions which may prevail locally.

Maintenance forces should be fully organized during the winter months to protect important locations during heavy snows or blizzards, such as outlying remote-control switches and interlocking plants. Each foreman should have his forces lined up to report automatically to their respective locations when conditions require. Cuts and other locations subject to the drifting of snow should be protected by snow fences. Shims and braces made to standard dimensions should be available in northern climates for use in correcting irregularities in the track due to heaving conditions in winter.

Minimize Slow Orders

Most heavy maintenance work can be accomplished best by specialized gangs under competent supervision. The use of specialized gangs, especially for surfacing and laying rail, is advantageous in reducing the number of slow orders, which, of necessity, are ordinarily required during the heavy maintenance season. Slow orders should be reduced to a minimum and should be spaced, so far as possible, to permit uniform speed of operation between them. For high-speed train operation, longer run-offs should be provided for comfortable riding, than those ordinarily made for unimportant passenger and freight trains.

The proper spacing of slow orders reduces train acceleration to a minimum. Considerable time is lost by a train in reducing speed from 80 or 90 m.p.h. to 25 m.p.h., and much more is lost while accelerating back to the permissible, authorized schedule speed. It has been observed that trains whose speed has been reduced to 10 to 15 m.p.h. require approximately eight miles to attain a speed of 90 m.p.h.

Track and bridge maintenance work should be programmed so far as possible to eliminate duplicate slow orders. This can be accomplished best by close cooperation between roadmasters and master carpenters. These men should work in close harmony to improve riding conditions at the ends of bridges, where it is most difficult to maintain proper riding conditions, and where work is frequently required on the part of both bridge and track forces.

Proper Tools Essential

Maintenance gangs should be mechanized so far as possible to permit the handling of work efficiently and economically. Properly trained supervision will permit carrying out work in line with standard practice or standard plans. Such gangs should be fully equipped with those up-to-date tools which are particularly adaptable to producing work with a high degree of efficiency and good workmanship. Level boards of an improved type should be used and should be checked frequently to insure their being in proper adjustment. This applies also to track gages, which should be checked daily. When they are found out of adjustment, they should be marked to prevent the possibility of their being used again before they have been repaired.

Motor cars and trailers are of importance, and should be maintained in a condition to expedite the movement of gangs to and from work. In fact, we cannot overlook the necessity of providing good tools of all kinds, as it is generally conceded that good work cannot be accomplished with poor or defective tools. It is important that track tools of all kinds be properly placed in tool boxes at

night and that the boxes be securely locked to prevent the possible use of the tools for malicious purposes by cranks or others.

Must Watch Details

The training of men for the proper supervision of specialized gangs is of the utmost importance. The roadmaster should give this close attention to see that there is a proper understanding of all duties and responsibilities. The foreman in charge of such gangs should be fully impressed with the importance of accuracy and high-class work in connection with the re-alining of the spirals of curves, and the maintenance of proper super-elevation throughout entire curves. The P. S. and P. C. of all curves should be identified by permanent markers and the changes in elevation on the spiral should be marked or painted on the rail where they will be readily available to the foreman when checking the elevation on the spiral and curve.

Foremen should be fully instructed as to the importance of maintaining proper line, as there is nothing that will cause poor riding track for high-speed trains quicker than track that is allowed to get out of line. It is equally important to maintain proper gage, as slight irregularities in gage will have the same effect on train operation as poor alinement.

The work of specialized gangs should be followed up by section forces to permit correcting irregularities in cross level, gage or line which might develop. The importance of this should not be overlooked, as there are usually numerous spots which do not develop until several days after the major work has been completed. It is the duty of the foremen of these small gangs to correct all of these small irregularities. I think all of you agree that one of the secrets of good track maintenance is to locate and correct small irregularities as soon as they develop, because if these are permitted to remain, they will not only become larger, but will result in the development of other irregularities.

Must Select Men Carefully

One of the most important duties of a roadmaster is to educate thoroughly the men under his jurisdiction, because with foremen untrained in the principles of good mechanics, it is practically impossible to maintain a railroad which is suitable for high-speed operation. To best accomplish this, he must canvass his forces carefully, taking into account the ability and merit of each employee, to permit the selection of those men who are outstanding and who have capacity for advancement. It is of greatest importance to select good men in the beginning.

These same considerations apply to the selection of section men, and should be thoroughly understood by section foremen. Instead of picking up anyone who happens to come along, they should attempt to get men with outstanding ability, with the view of having good material available for training and promotion.

I cannot impress upon you too strongly the importance of building up a strong organization. There are three outstanding items in the maintenance of a railroad—labor, material and tools. These three items go hand in hand. If we have tools and a large force of men, without material, little, if anything, can be accomplished. If we have men and material without proper tools to execute the work, little, if anything, can be accomplished. Likewise, if we have material and tools, and do not have good men to use them, we are practically in the same position.

I speak of this in connection with the maintenance of track for high-speed trains to bring out the relative importance of each of these factors. One of the principal obstacles with which we are confronted today is that of securing capable men in the maintenance of way department—men who will take an interest in their work, with the result that they will become highly proficient. I am satisfied that if this obstacle can be overcome, we will continue to maintain our tracks suitable for the operation of high-speed trains with safety and comfort. It is up to you roadmasters to develop your organizations. With increased efficiency of your man-power, you will make great strides toward maintaining the property for which you are responsible, in first-class condition.

Higher Speeds in Future

As stated before, we are today operating trains between 90 to 100 m.p.h. In my opinion, within the next ten years such speeds will be increased to 115 to 125 m.p.h. on tangents with safety, with appropriate restrictions on curves. This can be accomplished through the development of steam locomotives and Diesel engines which are specially designed and constructed for high speed, and through continued refinements in track maintenance. I am satisfied that you men, who have the responsibility of track maintenance, have been doing your work successfully, and that when the future higher speeds are obtained, you will meet your part of the obligation.

Section Headquarters—What is the Economical Location?

By Thomas Walker

Roadmaster,
Louisville & Nashville, Evansville, Ind.

OWING to changes in section limits on many railroads in recent years, the question has arisen many times as to where the new section headquarters shall be. A simple method of determining the cost of the time spent by a gang going to and from work with various locations of headquarters on any particular section, is set forth in this article. Such costs, when determined, can then be evaluated with other considerations entering into the location of the section headquarters.

"Assume for example a section ten miles long from A to B (see diagram below), with section headquarters at X, and also that (a) represents the distance from X to A and (b) the distance from X to B. Assume again that the section foreman covers his section uniformly by working one day on mile 1, the next day on mile 2, and

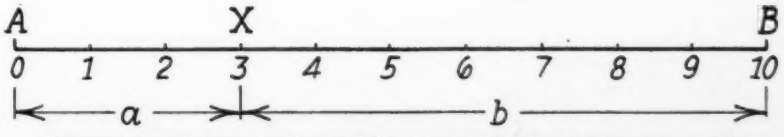


Diagram Representing a Section 10 Miles Long, With the Headquarters at "X"

so on. On this basis, his motor car mileage to the middle of mile 1 and back to the tool house the first day would be 5 miles. The second day he would make 3 miles, or to the middle of mile 2 and back. Working uniformly from A to B in this manner, the mileage which would be made on each of ten successive days would be 5-3-1-1-3-5-7-9-11-13, and the total for this period would be 58 miles. The average daily mileage would be 58 divided by 10 or 5.8 miles.

In the list of the daily mileages above, the sum of the first three, (to the left of X) is 9, or the square of the distance from X to A, which is a^2, and the sum of the remaining seven mileages (to the right of X) is 49, or the square of the distance from X to B, which is b^2. The average daily mileage (total mileage, divided by total number of days) can be accurately expressed then by the formula: $\frac{a^2 + b^2}{a + b}$ equals average daily mileage traveled. This mileage is only for the gang going to and from work and does not take into consideration other motor car operation during the day.

Many Factors Enter Into the Most Satisfactory Location for the Headquarters on Any Particular Section

When Changing Section Limits

This simple formula can be used to advantage in cases involving changes in sectional limits. For example, assume changes have been made requiring a 16-mile section with two possible locations for section headquarters, one of which is two miles from one end of the section and the other seven miles from the end of the section. In the first case, using the formula $\frac{a^2 + b^2}{a + b}$ the average daily mileage would be $\frac{2^2 + 14^2}{2 + 14}$ or 12.5 miles. In the second case, the mileage would be $\frac{7^2 + 9^2}{7 + 9}$ or 8.1 miles. The difference is 4.4 miles per day and for a month with 22 working days, the total difference in mileage would be 96.8 miles. If we divide this by the average speed of the motor car going to and from work we obtain the gang hours lost per month. Using 15 miles per hour as an average speed consistent with safety and rules, the gang hours lost per month would be 6.4, or nearly a day for the entire gang. Multiplying the gang hours lost by the hourly wages of the gang and adding the cost of operating the motor car the additional mileage, the total difference in cost for going to and from work can be reduced to dollars and cents. This cost can then be considered with other reasons for adopting either location.

Rail Manufacture and Maintenance

(Continued from page 670)

due to hasty initial laying, resulting in poor line and surface, with the excessive truck nosing and rocking which results.

More accurate line and gage can be obtained through the use of double-shoulder tie plates, especially where independent lagging is employed. Some have expressed the belief that the width between the shoulders is excessive, but necessary mill tolerances for rail bases and tie plates make this difficult to reduce. While the desired practice is to place the outside shoulders in contact with the rail flange, a considerable number of the plates will be found with their inner shoulders contacting the rail flange. In a way this tends to hold the rails against both inward and outward thrusts.

While care has been directed constantly to secure proper expansion at joints, it is found in practice that differences develop immediately as rail laying advances and that a wide variation is found from rail to rail. Part of this comes from the rebound of one rail against the other, and can be controlled by care in laying. Part comes from loose, or partial bolting, and some from the delayed application of rail anti-creepers. Erratic batter of individual joints may be attributed in part to these conditions.

When building up rail ends, the entire joint assembly and its supporting ballast and track structure must be taken into account. Thus, renewal of bars and bolts, a possible change of the plates on the joint ties to those of heavier design and effectiveness, anchorage, and other features must be weighed, along with building-up programs. Otherwise the full effect of the building-up work will not be realized. Some prefer the out-of-face building-up of rail ends, while others consider each joint individually as to what correction is necessary. Building up the rail end surface should follow and not precede the change of bars or their reinforcement. Changing bars after rail end welding has been completed may and frequently does change the entire situation at the joints, frequently resulting in high joints, an undesirable condition.

Problem of Old Rail

The chief concern of those directly connected with the maintenance of track is not so much what can be done with the small percentage of new rail received from time to time, but rather the far greater problems presented by the miles upon miles of old rail in track, to get the utmost out of it. Section foremen, roadmasters and others invariably say that their chief difficulty with old rail is that it is surface bent, has its ends pounded down, and requires too much labor to keep it up. Frequently the rail is not in need of renewal, but the entire track structure requires overhauling from the ground up. I have been impressed with what can be accomplished in smoothing off the top of rail with grinding equipment of the type placed in operation recently on the Pennsylvania. These grinders perform a very useful service, not only in reducing corrugations, but also in touching up the edges of burns, correcting end batter in a measure, and smoothing off other surface irregularities, thus going far to dispel the illusion of the so-called surface bent rail—one of the chief complaints of a large body of maintenance men.

Many miles of alleged worn out rails can be restored to service and at nominal expense by such economical means as the reconditioning of joints, the building up of rail ends and surface grinding of the type mentioned, coupled with a fair percentage of tie renewals and a surface lift. These measures will extend the life of a large mileage of rail until financial conditions will permit the greater expenditure for a complete renewal job, involving the installation of heavier rail and fixtures, and a program of tie renewals and ballasting.

Seek Answers at B. & B. Convention

Bridge, building and water service men from all parts of the country gave detailed consideration to many of their current problems at a three-day meeting in Chicago. A running report of the convention activities, together with the eight committee reports presented, are included herewith, along with reference to the constructive exhibit of materials and equipment presented by the Bridge and Building Supply Men's Association

The Rock Island's New Cimarron River Bridge Is An Outstanding Example of Recent Bridge Construction

THE forty-sixth annual convention of the American Railway Bridge and Building Association, which was held at the Hotel Stevens, Chicago, on October 17-19, with 171 in attendance, reflected throughout its program the many new problems which confront railway bridge, building and water service men today, and a continuing determination on the part of these men to meet these problems in the most effective and economical manner. At the various sessions of the meeting, all of which were presided over by President Armstrong Chinn, chief engineer of the Alton, consideration was given to eight committee reports on The Maintenance of Shop and Enginehouse Roofs; Deteriorated Concrete—Causes, Detection and Methods of Repair; Bridge Painting Problems Resulting From Deferred Maintenance; The Elimination of Slow Orders in Connection with Bridge Repair and Renewal; The Use of Preframed Treated Timber for Replacement Purposes; Present-Day Methods of Safeguarding Bridge Structures; and Glazing Maintenance in Shops and Enginehouses.

These technical reports were supplemented by papers presented by J. F. Leonard, engineer bridges and buildings, Central region, Pennsylvania, on Maintaining Old Masonry; by G. A. Haggander, assistant chief engineer, Chicago, Burlington & Quincy, on The Strengthening of Old Bridges to Meet the Demands of Today's Traffic; and by A. T. Hawk, engineer of buildings, Chicago, Rock Island & Pacific, on Meeting Today's Requirements in Railway Structures.

Railway Structures

Special features of the program included the showing of the picture entitled Trees and Men, on Tuesday evening, portraying logging and lumbering operations, which was presented through the courtesy of the Weyerhaeuser Sales Company; the annual luncheon on Wednesday, with more than 200 members and guests in attendance, who were addressed by Samuel O. Dunn, editor of the *Railway Age;* the annual joint dinner on Wednesday night with members of the Bridge and Building Supply Men's Association, which was attended by 190; and a trip on Thursday, following adjournment, through the paint manufacturing plant of the Sherwin-Williams Company at Kensington, Ill. As an integral part of the convention, 31 member companies of the Bridge and Building Supply Men's Association presented an interesting and constructive exhibit of the latest developments in materials, equipment and appliances employed in the construction and maintenance of bridges, buildings, water service and other railway facilities.

In the election of officers for the ensuing year, A. E. Bechtelheimer, assistant bridge engineer, Chicago & North Western, Chicago, was advanced from second vice-president to president; F. H. Kramer, bridge engineer, Chicago, Burlington & Quincy, Chicago, was re-elected first vice-president; H. M. Church, general supervisor bridges and buildings, Chesapeake & Ohio, Richmond, Va., was advanced from third vice-president to second vice-president; R. E. Dove, assistant engineer, Chicago, Milwaukee, St. Paul & Pacific, Chicago, was advanced from fourth vice-president to third vice-president; and F. H. Soothill, chief estimator, Illinois Central, Chicago, was elected fourth vice-president, to succeed Mr. Dove. C. A. Lichty was re-elected secretary-treasurer, and the following were elected directors: L. G. Byrd,

supervisor bridges and buildings, Missouri Pacific, Poplar Bluff, Mo.; K. L. Miner, supervisor bridges and buildings, New York Central, Beacon, N.Y.; and A. M. Knowles, assistant engineer structures, Erie, Cleveland, Ohio.

The secretary's report showed that with 48 new members taken in during the year, there are now 573 active members of the association in good standing. Chicago was selected as the convention city for 1940.

Live Subjects Up for Study

The following subjects were selected for study by committees of the association during the coming year: The Detection and Elimination of Termites in Railway Buildings; The Inspection of Buildings to Formulate the Maintenance Program; The Heating of Shop and Terminal Buildings; The Mechanization of Bridge and Building Forces; The Storage and Delivery of Bridge and Building Materials; Protecting Steel Structures from Severe Corrosion; The Repair and Renewal of Ballast-Deck Bridges; and The Effect of Increased Train Speeds and Larger Locomotive Tenders on Water Storage and Delivery.

C. E. Johnston Opens Convention

The convention was opened with an address by C. E. Johnston, chairman, Western Association of Railway Executives, and with greetings from both the American Railway Engineering Association and the Roadmasters and Maintenance of Way Association. Pointing to unsettled world conditions and the important part that the railways of this country must play in the event that we become involved in war, Mr. Johnston called upon those present to give their best in solving the large problems which confront the railways, and asked, "Could we, in your judgment, entrust this large job to our competing forms of transportation?" Answering his own question, he said that we all know that only the railroads are adequate to this task, but cautioned that we must realize that no high standard of railroad maintenance and operation can be provided without complete and intelligent interest on the part of all those engaged in railway work.

Continuing, Mr. Johnston reviewed the large part which the railways have played in the growth and well-being of the country, but contended that large as this has been, there is still greater need for the railways today than at any time in the past. "No further proof of this is required," he said, "than for you to imagine the chaos which would exist if railroad service were 'blacked out' for a month, a week, or even a day."

As the result of the initiative and energy with which railway men have undertaken their new problems in recent years, as exemplified by the improvements which have been made in both passenger and freight service, Mr. Johnston saw a lessened threat by competing forms of transportation, on the highways and waterways, and in the air, but he decried the unfair advantages possessed by these competing forms of transportation in the way of subsidies, inequitable taxation and regulation, and demanded equal opportunity for the railways and that present discrimination be stopped. "These unfair advantages enjoyed by other forms of transportation," he said, "can be removed only by an informed and intelligent public opinion, recognizing that all agencies of transportation should and must pay their own way. In summing up his remarks, Mr. Johnston said:

"The railroad industry is not dead; the railroad industry is not dying; the railroad industry is ready, willing and able to march forward with America to new and even greater achievements. The commanding position occupied by the railroads as a privately-owned and operated industry should cause us, as a part of this industry, a feeling of pride so great as to leave no room or reason whatsoever for a feeling of discouragement. If we who are engaged in this industry make a properly organized effort, if we show real fortitude, if we counter the attacks of demagogues, we can make ourselves a real factor in framing public policies that will correct some of the evils that now prove so burdensome to the railways."

Armstrong Chinn
President

As a district engineer maintenance of way on the Burlington, and as chief engineer of the Alton for the last 10 years, Mr. Chinn has had wide experience in all phases of maintenance of way and structures work. He was president of the Roadmasters' Association in 1936, and has been an active member of the Bridge and Building Association since 1930.

Greetings

Greetings from the American Railway Engineering Association were conveyed by its President, E. M. Hastings, chief engineer of the Richmond, Fredericksburg & Potomac, who spoke of the important place filled by the Bridge and Building Association in the adequate maintenance of the railways, but who called for even greater diligence and determination on the part of bridge and building men in facing the large problems of the future. He also spoke of the desirable trend away from the too rigid curtailment of maintenance expenditures, saying, in part, as follows:

"Too often it has been the practice to treat our railway structures much as a red-headed stepchild. Economy or the saving in money that is made by a reduction or curtailment in the maintenance of bridges and buildings is one that is not lasting; for the moment a few dollars may be saved, but in the long run we generally find that more dollars are spent. I believe that there is a very definite trend away from curtailment in the maintenance of bridges and buildings and that the importance of proper maintenance is being more fully recognized today than ever before. If this is true, then the opportunity that is open to the members of your association is a very challenging one, and one that will require the very best that you can give.

"We are living these days in a disturbed world. War and confusion are on almost every side. Therefore, we men who must help guide the railway industry aright need to keep our thinking clear, our motives honest and our dealings fair—solving our railway problems with the welfare of the whole industry foremost, and, while looking backward with just pride and satisfaction on the accomplishments of the past, press forward determined to perform greater service for our industry in the future."

G. L. Sitton, president of the Road-

masters' and Maintenance of Way Association, and chief engineer maintenance of way and structures of the Eastern lines of the Southern, brought greetings from his association, and, after expressing his high regard for the work of the Bridge and Building Association over the years, stressed the importance of the close co-operation which has always existed between bridge and building men and those in the track department. In this regard, Mr. Sitton said, in part, as follows:

"There never was a time in our lives when we needed to know so much about so many things as we do today. We are living in an age of rapid changes. Practices and materials that were satisfactory only a few years ago are now being discarded as out of date. Railroad maintenance men must keep awake, must look ahead, and must learn about up-to-date methods in order to meet the challenge of these times. How well your organization is undertaking to keep up-to-date is evidenced clearly in the program of your convention, with eight committee reports, all on strictly up-to-date subjects, subjects which would not have been considered of major importance a generation ago.

"The Roadmasters and Maintenance of Way Association and your association have worked hand in hand through many years, and on individual roads, the two departments which they represent have worked side by side in a common cause, namely, to maintain the physical properties of the railways to as high a standard as is humanly possible with the funds available. I am sure that no other departments on the railways were ever more closely related, or realized more fully the dependence of one on the other. Truly, we have shown that we know the meaning of the word co-operation."

President Chinn Speaks

In his presidential address, President Chinn reviewed the activities of the association during the year and compared its large accomplishments in recent years with those of the early days of its activities, beginning in 1891, when the Proceedings were volumes of only a few pages. But in spite of all that has been accomplished, he saw large opportunities for still more constructive work in the days that are ahead, and urged wider membership in the association among those men on the railways in charge of bridge and building maintenance work, regardless of their titles. Concerning the railway situation today, the importance of the railways in the economic and national defense systems of the country, and the part that must be played by bridge and building men, Mr. Chinn said, in part, as follows:

"Today we are again entering a period of uncertainty and world unrest. A war between great nations in Europe is under way. Where it may lead no one knows, but its effects are already being felt in our country and the extent to which we may become involved is uppermost in the public mind. But no matter what the final outcome to this conflict may be, it is certain that we will still have much work on our railroads to attend to, the extent and importance of which will be in proportion to the national emergency which arises. That this is true is nowhere better evidenced than in recent trends in Europe where one of the first activities of a warring nation in its efforts to cripple an enemy has been the destruction of its systems of transportation. This has involved the blowing up of railroad terminals and bridges, for it is recognized that an enemy whose means of transportation have been destroyed is half defeated.

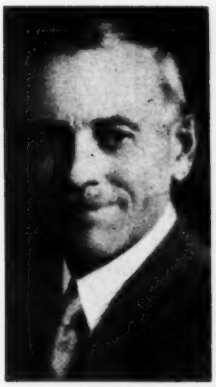
"Transportation is probably the most valuable and useful commodity in our country, for on it depends our national prosperity, unity and strength our conveniences and comforts of life, our health and our way of living. Take our transportation from us and

F. H. Cramer
First Vice-President

A. E. Bechtelheimer
Second Vice-President

H. M. Church
Third Vice-President

R. E. Dove
Fourth Vice-President



C. A. Lichty
Secretary-Treasurer

Bridge and Building Association

Officers 1938-39

Armstrong Chinn, President, chief engineer, Alton, Chicago.

F. H. Cramer, First Vice-President, bridge engineer, C. B. & Q., Chicago.

A. E. Bechtelheimer, Second Vice-President, assistant bridge engineer, C. & N. W., Chicago.

H. M. Church, Third Vice-President, general supervisor bridges and buildings, C. & O., Richmond, Va.

R. E. Dove, Fourth Vice-President, assistant engineer, C. M. St. P. & P., Chicago.

C. A. Lichty, Secretary-Treasurer, Chicago.

Executive Committee

C. M. Burpee, Past President, managing editor, Railway Engineering and Maintenance Cyclopedia, Chicago.

(Terms Expire October, 1939)

L. G. Byrd, supervisor bridges and buildings, M. P., Poplar Bluff, Mo.

W. R. Ganser, master carpenter, Long Island, Jamaica, N.Y.

F. H. Soothill, chief estimator, I. C., Chicago.

(Terms Expire October, 1940)

B. R. Meyers, assistant engineer, C. & N. W., Sioux City, Ia.

W. Walkden, bridge engineer, C. N. R., Winnipeg, Man.

A. S. Krefting, assistant engineer, M. St. P. & S. S. M., Minneapolis, Minn.

we would disintegrate economically, socially and nationally. Stop the railroads and dire want and necessity would be felt in congested areas in less than two weeks, and from there would spread quickly to the entire country. Why is it that in spite of subsidized competition and countless unfair and unreasonable laws restricting the railways they still operate and progress? The answer is our country needs them and knows that it cannot get along without them. The railroads have been accused many times of being backward, of having little or no initiative and of failing to develop and to keep abreast of the general advance of our modern age. The work of our association is evidence to the contrary, and shows that the railroads do have initiative and are making advances, and our association is only one of several that are devoting their time and energy to the advancement of the science of railroading. The part that bridge and building men have had in this progress can be found readily in a comparison of early railroad bridges and buildings with those of the present day.

"But, you may say that the days of railroad expansion are over and that our problem is now to maintain what we have. This is true to a certain extent, but we must also constantly improve what we have if we are to meet competition and stay in business. At the same time, while we are making these improvements, we must not lose sight of the importance of maintaining the property we have. No matter how well a structure may be built, it is of no value unless it is used, and the more it is used the more maintenance it will require. So it behooves us, as individuals and as an association, to continue our efforts and our studies to improve our railroads and our methods of maintaining them.

"One of the attractions of railroading is the knowledge that no matter how proficient we become in performing our tasks, we never reach perfection, as there are always better and more economical ways of doing what we have to do, if we can only discover them. The field of railroading is wide open to men with imagination and alert, inquisitive and studious minds. American foresight, energy and efficiency created and built our railroads. The same foresight, energy and efficiency will keep them running."

Government Interference Must Stop Says Samuel O. Dunn

Addressing the annual luncheon on Wednesday, Samuel O. Dunn, editor of the *Railway Age,* saw business conditions of the country showing some improvement, with larger than seasonal increases in railway car loadings, but warned that there are many domestic economic problems still to be solved, and cautioned that the people of this country must not permit these problems to be pushed into the background or to be complicated by further government interference with business, on the pretext that such proceedure is necessary to meet world conditions or to prepare us for a national emergency. Mr. Dunn said in part, as follows:

"We meet in one of the most tragic periods in the history of the world. The recent beginning of the war in Europe makes it difficult for us to consider any of our domestic problems without reference to the possible effects of the war. In regard to this situation, I venture three very positive opinions: First, that it is foolish to say, as some do, that we cannot keep out of this war; second, that we should spare no effort or expenditure which may be necessary to put our country in a condition to defend itself against any other nation or combination of nations; and third, and one which I emphasize, that I consider one of the greatest dangers with which we are confronted to be that we will allow the war and its effects to divert our attention from our own great domestic problems, which include, of course, our railroad problem.

"We have been and still are economically in a bad condition in this country. The necessity of facing and really solving these economic problems of increasing our production and our national income is essential, not only to our prosperity, but also to insure that in case we become involved in a war, we will be prepared economically for it. And economic preparedness is quite as essential to a nation as military preparedness. In my opinion, the only way that we can prepare ourselves economically for either peace or war is by adopting those policies which are necessary to restore our production and our national income. As regards our railroads, this means that it is necessary to so equip them as to make sure they will be able to meet any traffic demands that may be made upon them, either by increases in business without our participation in war, or by increases in business due to our entrance into war.

"What has occurred in this country since this war began has been, economically speaking, entirely different from what occurred immediately after the war began in 1914. At that time business in this country was poor and declining, and for some months following the beginning of war in Europe business here declined. That temporary decline in business, however, was followed speedily by a very large increase of business, due partly, no doubt, and perhaps in large measure, to increased purchases from abroad.

"This time, the beginning of the war was followed immediately by a sharp advance in the stock market and by one of the largest increases of traffic within a short time that ever occurred in history. The question is, will that phenomenal increase in traffic continue, or will it slip back or will it increase further? However, I think that we can easily exaggerate the amount of business that we are going to get from the belligerent countries, because they are all in debt to us and have no credit. At the same time, the belligerent countries in Europe are losing their foreign markets, and it occurs to me that our manufacturers in this country, including our railway equipment and supply manufacturers, may anticipate very substantial increases of their business from other foreign countries that are not at war. But, after all, we must rely principally upon increased business and increased production in our own country for whatever increases of prosperity we may have.

"Regardless of the war situation and the so-called emergency, we should not only guard against increasing government interference with various kinds of business, but should exert the utmost pressure of which we are capable to reduce government in business, because the prosperity of a country is created by free private enterprise. The great danger is that when there is so much talk about us becoming involved in war, the public may become more disposed rather than less disposed to increase the power of politicians.

"If we get into a war, there will be plenty of increase in government. That is my principal reason for believing that we should do our utmost to keep out of war, and why I emphasize that it is the duty of every one of us as citizens to do our utmost to keep public minds, as far as possible, concentrated on our domestic problems and especially on our domes-

tic economic problems, resisting all efforts by government to increase government interference with business upon the pretext that it is necessary to help prepare us for war; because it isn't necessary and it is the exact opposite of necessary. What is necessary economically to prepare us for war is to put our industries in the best and most prosperous condition possible. And that means giving private enterprise the greatest possible opportunity to do its work of rehabilitating our industries, and thus restore prosperity."

The Elimination of Slow Orders in Connection with Bridge Repair and Renewal

Report of Committee

FROM the standpoint of train operation, the ideal condition during repair or renewal work on a bridge demands that the track be safe for full speed, and that there be no slow orders. On the other hand, from the standpoint of the force carrying out the work, the perfect arrangement would be that there be no traffic on the rails. This latter condition, at best, can be obtained for only short periods of time on any operating railroad and, accordingly, many problems have to be solved in the planning and execution of bridge work in order to satisfy the demands for ideal train operating conditions or to meet them as nearly as possible. During recent years, the increasing speeds of trains in both passenger and freight service have served to put the bridge department "on the spot" more than ever before, to plan and regulate its work to prevent slow orders whenever possible.

In the 1938 proceedings of the American Railway Engineering Association a table is presented giving information on 30 streamlined or high-speed trains operating in the United States and Canada. This table shows that one of these trains covers 1,034 miles each trip at an average speed of 65 m.p.h., and that four others cover from 2,228 to 2,298 miles each trip, at average speeds of 56 to 58 m.p.h. The total mileage of the single trips of the 30 trains is 18,489. Freight train speeds have also increased greatly in recent years and, strange as it may seem, such speeds have increased proportionately more than those of passenger trains.

If a fast train has an unscheduled delay, a note is dropped off by the conductor or engineer at the first telegraph station beyond the point of delay explaining the loss of time. This report is quickly transmitted to the dispatcher, and delays to important trains are reported promptly to the division and general operating officers, who, in turn, determine and place the responsibility. The result of this practice has been to reduce avoidable delays to a minimum. The effect on bridge maintenance officers and men

H. B. Christianson
Chairman

is to make them apply the rule of necessity alone, and not that of convenience or previous practice, in placing slow orders.

Traffic Must Be Safeguarded

Railroad maintenance work must be carried out in such manner that traffic is safeguarded at all times. The elimination of slow orders cannot and does not entail any risk to the safe operation of trains, or any additional hazard to employees engaged in the work of bridge maintenance. There is a tendency on the part of some to become concerned about the prevention of slow orders, thinking that supervisors or foremen may overlook the safety factor required and attempt to do work without slow orders that are necessary. It must be recognized that any work which renders a bridge structure unsafe for train operation demands flagging protection, and that the reduction or elimination of slow orders with a sacrifice of safety cannot be countenanced. Any tendency of a foreman to disregard this first rule of railroad operation must be corrected promptly and decisively.

Train orders that are issued for protection on account of bridge work may be divided into two general classifications: First, those which effect a reduction of train speed over a bridge that is not considered safe for traffic at normal speed (such a location must be further protected with fixed signals), and second, those for the protection of impassible track, in which case qualified flagmen with flagging equipment must be stationed to insure observance of the order.

Strengthen Falsework

Slow orders in the first classification may be eliminated in the following ways: (A)—By constructing falsework of adequate strength to permit the passage of trains at normal speed. This can be accomplished by spending additional money for labor and material to make the falsework strong and rigid enough to support traffic at normal speeds. There are instances, of course, where falsework must be keyed, shimmed or blocked up, or where the available space is limited, so that the structure cannot be made fit for high speeds. Such cases are exceptional, however, and, as a general rule, by full-bolting and proper bracing, the falsework can be made safe for normal speeds. Bridge engineers have recognized the necessity for this procedure and are now designing falsework accordingly for heavy loads and high-speed service.

(B) By maintaining line and surface conditions suitable for normal speeds at all times and by making corrections immediately whenever the track becomes unfit for such speeds. As an illustration, the driving of piles through the track structure usually causes it to heave out of line and surface. High-speed track so disturbed generally must be restored to its original position, and it may be found necessary to lower it by cutting out ballast from beneath the ties, when formerly the track would have been surfaced to the high spots. High-speed trains have compelled us to make such corrections to a much greater degree of refinement than ever before.

Rough track conditions are often brought about when making spot floor renewals on open-deck structures, even though there may be no change in the dimensions of the ties. The rail will set up higher on the new ties than on the old, the height depending upon the depth to which the tie plates had become imbedded in the old ties, as well as upon the amount of wear on the parts renewed. The resulting unevenness in the rail support at the point where the new ties adjoin the old is liable to produce a rough spot under a fast-moving train and slow orders have been known to have been placed for high-speed trains at such points. Instances of this kind are becoming very infrequent, however, as bridge men have become aware of the necessity for maintaining a surface and line condition that insures the smooth movement of high-speed trains.

Close co-operation between track and bridge forces has been found indispensable whenever work is in progress that calls for adjustment of the track over a bridge. Both section and bridge foremen are qualified judges of good surface and line, and the section foreman has direct responsibility for correcting or reporting all spots on his section that might cause rough riding. The division engineer can be very helpful in insuring the desired teamwork by advising the track supervisors of all bridge work that is planned which might require the assistance of the track forces. The work can then be planned systematically so that the section foreman will be on hand with the required force to maintain smooth approaches and to assist in many other ways to accomplish a first-class job.

Diverting Traffic

Delays to trains by reason of impassable track in connection with bridge repairs and renewals are being reduced in number by a large variety of methods, some of which are discussed in the following:

(A)—By diverting traffic over another track in multiple-track territory.

In the past, this method has been used largely to expedite maintenance work, and where existing crossovers were not available, temporary ones were provided if it was shown to be economical to do so and that operating conditions were favorable for diversion. However, the elimination of a slow order at a bridge by this method usually calls for reduced speeds through turnouts or crossovers at both ends of the diversion sections, and since the permissible speed is quite low for all but the longest crossovers and turnouts, high-speed trains demand No. 16 or No. 20 turnouts for diversion purposes which will permit speeds of about 40 m.p.h. Although loss of time cannot be eliminated entirely by this method, the work at the bridge site is speeded up, service is restored to normal sooner and, even if the diversion of the more important trains is not permitted, time is often gained by the diversion of trains of lesser importance, at little or no inconvenience to operation. To accomplish the best results by this method, the supervisor must work very closely with the superintendent and dispatcher and secure their co-operation.

(B)—By building a run-around track or "shoo-fly" to carry traffic while the regular track is out of service because of repair or construction work.

Slow orders are seldom eliminated entirely by the use of this method. Turnouts, restricting curvatures, and the soft fill conditions usually involved, are factors that control the speed when this method is used. Where a temporary bridge must be built on the shoo-fly, it should be designed to carry traffic without the necessity for a special speed restriction over it. As a general rule, 40 m.p.h. is the limiting speed over shoo-flies because of the conditions mentioned above. Because of the expense involved, the lengthening of a shoo-fly to reduce curvature to the extent that it will not be a speed restricting factor is seldom justified. The relocation of automatic signals or the installation of additional signals is also often a requirement in connection with shoo-fly construction. It is evident that the job at hand must be a large one to justify the use of this method of avoiding the necessity for slow orders, and that the line must be a very important one to warrant temporary construction of this type, adequate to permit normal train speed.

(C)—By making bridge repairs and renewals under traffic, doing the work that renders the track unsafe between the time of trains.

Work which requires that the track be made unsafe for trains must be carried out under full flag protection, the flagmen being called in when the track is restored to service for full-speed operation. The replacement of the floors of open-deck structures, the driving of piles, the renewing of caps and stringers, the replacing of connecting members, loose rivets and pins and, sometimes, the renewal of an entire span or bridge structure, is work that comes under this classification.

On divisions where streamlined trains are operated, the track must be made safe for their normal speeds well in advance of the time they are due. A bridge foreman will not open up the track ahead of such trains unless he knows that he can restore it to normal service condition and be able to notify his flagmen in time to avoid any train delay. In some cases telephones are being used for communication between the foreman at the job and his flagmen. On many roads the minimum distance from the point of obstruction to the flagman's station is 1⅛ miles. Under such conditions, much time can be lost needlessly and trains may be delayed unless there is an effective and absolutely safe means of communication for flagging.

Bridge men have learned that it pays to plan every move carefully and to leave nothing to guesswork, whether it be in the renewal of a single member or the replacement of an entire span or structure. Every measurement must be checked, every piece of material must be accounted for, and the plan under which work is to be carried out must be thoroughly understood by all members of the crew before the track is opened.

Roll New Spans Into Place

Members of this committee have reported that a number of span renewals have been accomplished between trains by rolling the new spans into place after their assembly on falsework alongside the track. This method, which has been in use for many years, has been highly perfected on some roads and usually involves very little interference to train operation.

Insofar as the basic methods of handling routine bridge repair jobs are concerned, there has been little change in recent years. A structural member is removed and another installed in its place. If the member is one that is required for the safe support of the train loads that pass over the structure, protection must be provided to insure that the structure is not used during the renewal process. The revision of bridge maintenance methods with respect to such renewal work has consisted almost altogether in separating the preparation work from the actual renewal work according to carefully laid out plans, and in making intensive use of the available time between trains.

Anyone with any experience in bridge work can recall instances of plans which have gone wrong because of faulty measurements, the creeping of rail, requiring that it be cut to make a connection, insufficient material and many other mistakes. Foremen who realize the amount of trouble that such mistakes cause are very careful not to make them. The results of the demands for the elimination of slow orders have been very gratifying, and

avoidable train delays occasioned by bridge repair work in high-speed territories have been relatively few.

Use of Power Tools

(D)—By the more general use of power tools and improved equipment, which has speeded up operations and thereby reduced the time required to carry out bridge jobs.

Present-Day Passenger and Freight Schedules Will Not Permit the Slow Orders of the Past

Off-track types of equipment are being used quite extensively on many roads. Such equipment includes crawler-type pile drivers, cranes, shovels and draglines. Off-track equipment may often be the deciding factor in the elimination of slow orders and its use should always be given consideration for extensive pile-driving operations.

Power tools have been put to excellent use in reducing the time required to do work, as compared with hand methods. Such tools include power saws, augers, wrenches, hammers, drills and concrete breakers. Without question, the use of power tools has been a decided help to bridge men in their efforts to eliminate delays to trains.

Use of Temporary Tracks

One railroad has recently completed a comprehensive bridge strengthening program on a single-track line 282 miles long. The work consisted of making repairs to and renewing spans, the construction or altering of piers and abutments, and the raising of bridges. The steel erection gangs consisted of a foreman and 14 men, each gang being equipped with a self-propelled track pile driver, a self-propelled locomotive crane, an air compressor, a concrete mixer, pumps, and all other necessary equipment, including portable telephones. Temporary construction tracks, long enough to hold the driver or crane and two cars of material, were built as near each bridge as possible whenever existing tracks were not available nearer than one-half mile from the bridge. All work that made the track impassable was carried out in the intervals between the passage of passenger and fast freight trains. Close co-operation was maintained with the train dispatcher so that the best times for taking the track out of service could be agreed upon in advance.

Construction Under Traffic

On another road, in territory where streamlined and other high-speed passenger and freight trains are operated, a number of steel, concrete and pile structures were built recently, which required the construction of falsework. All piles were driven without the use of slow orders for any class of train. They were driven between train times under flag protection and any unevenness that developed in the surface or line of the track during the course of the work was taken care of immediately. Nor were slow orders used when excavating trenches about 5 ft. wide and 4 ft. deep to cut off the piles. If a train became due before a bent could be capped, the track was blocked up with timber and wedged on the piles that had been cut off, or on the ground between the piles. After all the piles in the bent were cut off, the cap was placed and the rails were blocked up and fastened securely, ready for high-speed operation. In the next step in this work, alternate track ties were replaced with bridge ties, after which the remainder of the ties and stringers were placed, a panel at a time, and were secured for high-speed traffic.

At the end of each day's work a temporary bulkhead was placed and the ballast was tamped behind it. If no train passed over the bridge before the gang left the job for the night, providing no opportunity to shim or tamp up spots that might settle under traffic, a slow order of 30 to 35 m.p.h. was put on the bridge. The pouring of the concrete floor, walls and wings was all carried on without slow orders. When the backfilling was done with earth it was allowed to settle for several months. If sand was used it was packed as thoroughly as possible by hand or by team, and was watered whenever water could be readily pumped. In this way, the length of time during which it was necessary to maintain slow orders after the falsework had been removed was shortened considerably.

Careful Planning Necessary

(E)—Bridge maintenance methods must, of necessity, include careful planning, an important part of which is the study of train movements and schedules.

Because of the greater attention being paid to train delays, methods of handling bridge repair work involving impassable track are gone over by superintendents and train dispatchers with division engineers and bridge supervisors much more intensively than in the past. The necessity for keeping passenger and time-freight trains on time by avoiding delays has thus brought about much closer co-operation between operating and maintenance men. Frequently there are trains that the superintendent and train dispatcher can set back or reschedule, and thereby expedite the work at the bridge and reduce or eliminate delays to other more important trains.

Design Stronger Falsework

The bridge engineers, in their present designs for falsework, have taken into consideration the requirements for high speed. On one road a standard plan of falsework pile trestle for heavy loading is used which provides for five-pile bents, a fibre stress of 1,605 lb. per sq. in. for the maximum loading, and that all connections be bolted in the same manner as in regular pile trestle design.

It is clear that the planning cannot be confined to that done on the job alone if a successful campaign to eliminate slow orders is to be carried out. Everybody, from the bridge engineer and superintendent down to the men who are doing the actual work, must plan together, and the man who schedules the time allotted to the foreman for work on structures in high-speed territories must consider the conditions surrounding the work.

The findings of the committee indicate that changes in bridge mainte-

nance methods to eliminate slow orders have consisted principally of building falsework of adequate strength to take care safely of the heaviest traffic moving at normal speed; of taking greater care to maintain proper surface and line for high-speed traffic; of taking full advantage of improved types of power tools and equipment; of perfecting established methods of bridge maintenance and best adapting them to the train schedules and operating conditions that exist; and of working in closer cooperation with operating officers than ever before.

Committee—H. B. Christianson (chairman), div. engr., C. M. St. P. & P., Savanna, Ill.; T. W. Pinard (vice-chairman), engr. b. & b., Penna., New York; J. E. Bird, asst. supv. b. & b., N. Y. C., Corning, N.Y.; H. M. Buell, bridge insp., U. P., Omaha, Neb.; R. W. Cook, gen. bridge insp., S. A. L., Norfolk, Va.; F. H. Cramer, bridge engr., C. B. & Q., Chicago; E. E. Fobes, asst. supv. b. & b., N. Y. C., Albany, N.Y.; R. L. Fox, rdm., Sou., Alexandria, Va.; F. C. Huntsman, office engr., Wabash, St. Louis, Mo.; D. E. Lewis, gen. foreman. b. & b., A. T. & S. F., Winslow, Ariz.; W. E. Maley, mast. carp., B. & O., Punxsutawney, Pa.; D. A. Manning, b. & b. supv., C. & N. W., Chicago; I. A. Moore, b. & b. supv., C. & E. I., Danville, Ill.; J. M. Salmon, Jr., asst. supv. b. & b., L. & N., Louisville, Ky.; I. L. Simmons, bridge engr., C. R. I. & P., Chicago; and J. G. Stice, bridge inspector, Illinois Central, Chicago, Ill.

Discussion

President Chinn opened the discussion by emphasizing the importance of eliminating slow orders because of present-day shortened train schedules. He stated that, after stopping, it may require 20 miles for a streamlined train to regain a top speed of 90 m.p.h., and that when running at 75 m.p.h. a passenger train that is required to stop, will lose from 4 to 5 minutes before regaining scheduled speed. G. E. Boyd *(Railway Engineering and Maintenance)* suggested that the regaining of top speed is very different from that of regaining time lost, and that to make up time lost trains must run for a considerable distance at much faster speed than their average speed.

M. D. Carothers (Alton) raised the question of reasonable speed restrictions, and stated that many foremen are inclined to place orders limiting the speed to 5 m.p.h. on bridges when the bridges are safe for considerably greater speeds. The reason for this, he said, is because the foremen allow a factor of safety to protect against the possibility of enginemen exceeding the restriction. It was his thought that the maximum safe speed should be allowed and that train crews should then be made to observe this speed.

A. M. Knowles (Erie) stated that frequently locomotive engineers use their own judgment as to what is the safe speed over a bridge, and added that, because of present higher train speeds, it is important to allow the maximum safe speed in slow orders, and equally important that locomotive engineers be impressed with the necessity for strict observance of the slow orders. All violations of such orders, he said, should be reported. Continuing the same thought, President Chinn stated that it is most important to eliminate permanent speed restrictions where fast schedules are involved, and that frequently this can be done at moderate expense.

J. F. Leonard (Penna.) felt that it is important to keep restricted speeds as high as possible, but cautioned that the primary consideration in placing slow orders is safety. He added that in the case of new construction work he favored a relatively low speed at first, with a gradual increase in the speed limit as conditions warrant.

Bridge Painting Problems Resulting From Deferred Maintenance

Report of Committee

THIS subject divides itself naturally into two sections, raising two broad questions: First, what are the problems resulting from the deferred painting of steel bridges, and, second, knowing what these problems are, what can be done about them? By studying replies to a questionnaire sent to the maintenance departments of the leading railroads in the United States and Canada, which comprise a total mileage of approximately 168,000, your committee obtained a comprehensive view of these problems and what is being done to meet them.

A Major Problem

The breaking of the paint film and its scaling to bare metal on steel bridges, is one of the major problems resulting from deferred painting. Prior to 1929 or 1930, the paint film was not allowed to break or scale before a new coat was applied. Since then the situation has changed. About half of the officers replying to our questionnaire admitted that in recent years they had allowed the paint film to break and scale before repainting.

R. W. Johnson
Chairman

If conditions make it impossible to keep a paint coat intact at all times, the question next arises whether the condition of broken and scaling paint films has serious consequences if the metal exposed is not allowed to pit. Practically all of the replies to this question stated that no harm was done to the steel, but that painting costs were increased because of the increased amount of cleaning required for subsequent painting. One reply called attention to the harm caused by scars where paint had scaled off, which scars held moisture and caused rusting quicker than where the surface is smooth.

Life of Paint Film

The service life of a paint film varies widely in the United States and Canada because it is subject to a wide variation in conditions. These conditions vary climatically from the salty, moist air of the Gulf coast to the dry, arid atmosphere of the southwest or northwest portions of the United States, and physically, from through-truss or girder-type bridges located on curves and subject to dense and

heavy traffic, including a considerable number of refrigerator cars, to deck-type bridges located on tangent track on remote branch lines with tri-weekly service and handling no refrigerator cars. Replies from the Gulf coast area indicated a life for an unbroken paint film of 2½ to 3 years. In desert country, replies indicated a life of 10, 12 and even 15 years. One road advised that in territory subject to heavy brine dripping, the top flanges of stringers have to be painted every year, but that on parts away from the track, such as truss members, paint lasts from 12 to 14 years, under favorable weather and operating conditions. One of the larger roads in the central west reported an average maximum paint life of seven years for bridges on the system, while another road in the same general area, but with more desert territory, stated that paint on its bridges lasted 8 to 12 years. One road near the Atlantic coast reported a life of 4 to 6 years for paint and another 6 to 7 years.

If the paint film is allowed to crack and scale, without injury to the steel before repainting, the average life of the paint job will be 2 to 4 years longer. Replies also indicated that in rare cases repainting has been deferred until the paint is 15, 17 and even 20 years old without causing damage serious enough to require steel repairs.

When paint is properly maintained and repainting is done before the paint film breaks, the labor cost of cleaning, as reported by various roads varies widely. Eleven roads estimate it as 20 per cent of the total labor cost; 11 other roads at 25 per cent; 2 roads at 30 per cent; 2 other roads at 35 per cent; 3 roads at 50 per cent; 1 road at 78 per cent; and still one more road at 75 to 95 per cent. The average of these estimates is approximately 30 per cent.

An interesting sidelight on the actual costs of a steel bridge paint job was furnished by a terminal railroad in the central region. This work was done in August, 1938, on a structure where painting had been deferred for several years. The cleaning was done by hand, using scrapers, files and wire brushes. The division of expense on this job was as follows: Cleaning steel, 57 per cent; scaffolding and rigging, 12 per cent, and actual painting, 31 per cent.

When a bridge painting job is deferred from year to year the labor charges will naturally rise. In order to obtain data on this problem the questionnaire asked, "Have you any idea or figures to show how your cost for cleaning increases per year for each year that painting is deferred beyond its usual life? For instance, if 25 per cent of the total labor is spent in cleaning with proper maintenance, would you say it would be 35 per cent for one year of deferred maintenance, 50 per cent for two years, etc.?"

Increased Cost of Cleaning

None of the roads could furnish figures in answer to this question, but practically all had ideas as to the increased cost. One road in the South reported that spans painted at the proper time were completed in one-third the time it had taken to do the job when the spans had been neglected too long. One of the large roads in the central west reported as follows: "Would say from practical experience that after paint has started to scale and peel, the cost of cleaning increases 10 per cent the first year, 25 per cent the second year, 50 per cent the third year, and from then on as high as 75 per cent." One of the roads in Canada reported 10 per cent added each year to a base percentage of 35 per cent; for example, the cost of cleaning would be 45 per cent of the total cost of painting at the end of one year of deferred painting and 55 per cent at the end of two years. Another Canadian road stated that it depends upon conditions, pointing out that rust and scale progress faster in brine territory or close to water, and that cleaning costs would average 75 per cent of the total cost if painting was deferred three years. A road in the South reported its cleaning costs as 40 per cent of the total the first year, 60 per cent the second year and 90 per cent the third year. An eastern road estimated 25 per cent increase for one year, 30 per cent for two years, 40 per cent for three years and 50 per cent for four years. Averaging the replies of about 30 roads we get a labor cost for cleaning of 35 to 40 per cent of the total cost of the paint job for painting deferred one year beyond its proper life; 50 per cent for two years, and 75 per cent for three years.

One road located in the northwestern part of the United States submitted the following actual figures to show the percentage of the total labor spent in cleaning bridges painted this year, on which the painting had been deferred from 1937: One through plate girder span 65 ft. long—56 per cent; one through Pratt span 137 ft. long—55 per cent; and four deck plate girder spans (3—60 ft. and 1—90 ft.)—60 per cent. This road stated that when painting was not deferred, cleaning costs were 20 per cent of the total labor costs.

The second major problem resulting from deferred painting is the pitting and reduction in section of certain members of steel bridges. To the question, "When the surface of the metal becomes roughened or marred by deterioration resulting from deferred painting, do you feel that all future coats will be more apt to fail sooner than if the surface had never been without protection," the officers of 20 roads answered yes; 9 answered no, with the qualification that the surface would have to be cleaned perfectly; and 5 said no.

Only a few of the 34 roads stated that they had not deferred painting until the steel structures actually needed repairs. The greater number admitted that they had, although they had, as one maintenance man expressed it, "not planned it that way." As a general rule these repairs were due more to actual conditions than to deferred maintenance, that is, members under the floor subject to excessive brine action could not be reached for proper painting often enough without removing and replacing the ties, which would have added a considerable amount to the cost of each painting.

Only about one-third of the roads reported that they used sandblasting to clean steel which had started to pit. The majority of the roads still clean with wire brushes, scrapers and chipping hammers. These are hand tools, but power tools, such as rotating wire brushes, pneumatic chipping hammers and scrapers, are being used to some extent. One road advised that it used pneumatic scaling tools after applying fuel oil to loosen rust and old paint.

Considerable Spot Painting

To stay or remedy the effects of deferred general painting, maintenance men have resorted to spot painting, touching up those parts of their bridges that are exposed to either brine or locomotive gas action, when required. In doing this spotting, many roads are using special coatings such as bridge cements, car cements, crude oil, asphalt oil, black oil with a slight asphalt content, slushing oils, asphalt paints, tar paints, asphalt roofing compounds, grease-like rust preventatives and rust removers, rust inhibitors and asphalt emulsions. Practically every road answering our questionnaire is trying out one or more of the above kinds of coatings. Some few have had unsatisfactory results, but the majority are beginning to standardize on some of these special coatings, although many are still being tested.

The heavier liquids and compounds which set and harden are intended to last for three or more years and are applied to cleaned surfaces. The greases and oils are applied directly

on top of rusty and scaly surfaces after loose scale has been brushed off, and in time penetrate and loosen the rust. Where rust conditions are severe, the grease and oil applications may have to be renewed as soon as six months, but under more favorable conditions, will last as long as three years.

One northern road stated, "We have used certain compounds for test purposes but have adopted the use of black oil with a slight asphalt content which is giving good results. The asphalt prevents evaporation of the oil and serves to retain it in place. After cinders and dirt have been cleaned off the steel, the oil is applied on all rusted portions, such as the top flanges of deck girders, floor beams, stringers, bottom flanges, lateral braces and gusset plates. It is seldom found necessary to apply the oil on the webs of girders unless the paint film has broken and rust has started. On all surfaces except those exposed to severe weather conditions, such as the tops of stringers between the ties, we have found that one application of oil lasts about three years, but on the top surfaces of stringers and floor beams we apply the oil once a year. This soon eats through all rust and heavy scale and so loosens it that it can be removed with a broom. The first application is made with paint spraying equipment, but subsequent coats are applied with a small mop to swab the oil on the steel in between the ties, etc. The cost of this work is approximately 6 cents per lin. ft. of single-track bridge for labor and material."

Six out of the 37 roads answering still had found nothing better than red lead and boiled linseed oil for priming coats and standard bridge paints for top coats. Practically all the roads agreed that, even if extensive staging is required to spot all portions requiring it, spotting should be done where necessary to protect all steel. Only 5 roads out of 34 would not erect a great amount of staging, one stating it would rather repaint.

The use of rust-penetrating compounds is not confined to spotting, but they are being used as a general bridge paint in localities where entire structures are exposed to brine action. An unusual application with large savings was made by a Southern road. Its experience and the results obtained are presented herewith in some detail:

This road has 20,631 lin. ft. of steel bridges. One-half of these are located within a few miles of the coast line of the Gulf of Mexico, in a low, damp climate. Those bridges are subjected to almost continuous salt-laden breezes from the Gulf and some are frequently covered with salt water spray. The other bridges are located inland in a semi-arid territory with little or nothing in the atmosphere to cause more than slight corrosion or rust during a period of several years.

Prior to 1930, three regular paint gangs were kept busy on these bridges at all times. There was little or no deferred paint maintenance. The cost of these gangs, in labor and material, was approximately $36,000 annually. In 1931 all regular paint gangs were disbanded and bridge painting was added to the duties of the very considerably reduced bridge repair gangs, with the result that little bridge painting was done for more than two years.

During the years 1931, 1932 and 1933, the bridges located near the Gulf of Mexico, due to neglect, suffered greatly from the ravages of rapidly forming rust and corrosion. All metal surfaces of entire bridges became covered with rust until the structures had the appearance of having had a dingy brown priming coat applied to them. The loss of metal was very considerable on these bridges during these years. In these same years, many of the bridges inland also became considerably rusted, but the loss of metal was slight compared to that on the structures nearer the coast.

Rust Removing Compound Applied

In 1933, in an effort to stop the loss of metal on the structures that were most severely rusted along the coast, this road began the application of a commercial rust-removing compound which experiments had indicated would stop the ravages of rust without the necessity for cleaning the metal prior to its application. The compound was not expensive compared with impervious film-forming paints and could be applied by unskilled labor. Within a few months the results obtained by the use of this compound were entirely satisfactory. It had penetrated the thickest coatings of rust and had rendered it inactive. The metal under the thick barnacles of rust was oily and the barnacles were saturated. Much of the heavier rust had loosened from the metal and fallen off of its own weight, leaving the surface oily and free of rust.

This compound was used very extensively during the years 1933 and 1934. All bridges requiring paint were treated with it. The loss of metal was stopped almost entirely. The expense in both labor and compound in each of these two years was approximately $9,000. In 1935, after having applied the compound to all bridges that required painting, and with more than two years experience in its use, the general instructions on this road were extended to include the use of this compound. These lines have not had any bridge paint gangs since 1931. Painting is done by the regular bridge repair gangs which are required to keep the compound on hand and apply it as directed by the supervisors of bridges.

Prior to 1931, annual bridge painting costs on these lines were $36,000 for both labor and material. In 1931, 1932 and 1933, during the depth of the economic depression, painting costs in labor and material were annually not in excess of $9,000. Since 1934, the annual outlay for bridge painting has not been more than $10,000 in any one year. Each year prior to 1934 the loss of metal in bridges was continuous, and in the depression years of 1931, 1932 and 1933, it was considerable. Subsequently to 1934, the loss of metal on bridges has been negligible; not as much as 20 per cent of the loss prior to that year.

All roads, with only a few exceptions, reported that more time has been spent on paint inspection since paint appropriations have been cut down, to insure that those structures most in need of paint will be given attention first. This spreads the paint allowance over all divisions. A few roads deviate from this practice and concentrate their painting on the most important bridges and on the more important divisions.

Inspection and Tools

Careful inspection is important, for on the judgment of the inspector, gained almost entirely through experience, depends the successful practice of obtaining the greatest practical life out of the paint. He must be able to detect the first signs of deterioration, decide whether this denotes a local or general condition, and picture what this condition will be one, two, or more years hence. He will be guided in his final decision by the age of the paint, kind of paint, location of the bridge and the nature of the traffic over it.

The use of power tools for cleaning to catch up on deferred painting is advocated by practically all the roads answering a question in this regard, the only exceptions being three of the larger roads who have confined the use of power tools to their larger painting jobs, and one of the large middle-western roads which has tried pneumatic tools, but doubts their safety, efficiency and economy as compared with hand tools.

The spray method of painting is used by 17 of the 29 roads replying to a question in this regard, although it appears that this method of painting was in use before deferred bridge

painting became so general, and only two of the above roads reported that they had adopted spray painting methods to catch up on deferred maintenance.

Those in charge of maintenance on most of the roads answering our questionnaire agree that deferred painting results in increased costs in the following order: First, due to more labor for cleaning; second, due to more material and labor needed for spot painting; and third, due to uneconomical painting, when money is available, because of the need for filling out the painting crews with inexperienced men and an attempt to crowd too much work into a limited season.

The following was submitted by a representative of one of our larger northwestern roads which seems to cover concisely and clearly what we are all striving to do in keeping our steel bridges protected. "The most economical way to carry on any painting program is to catch the steel before or as soon as the paint film starts to fail, being sure that it does not get to the point of peeling. A coat of paint at this time gives new life to the old film and the cost of preparing the surface is small. If painting is deferred until peeling starts, cleaning costs are excessive, and corrosion results in loss of a certain amount of the steel itself. After corrosion once starts it is difficult and expensive to check, and I doubt very much whether it can ever be checked completely after it has once gotten under way."

The deferring of the painting of steel bridges has not been as general as on buildings. To the question, "Do you consider that you still have deferred painting? If so, at your normal allowance for painting, how many years or part of a year are you behind?" 28 roads replied as follows:

9—No deferred painting
5—1 year of deferred painting
2—1½ years of deferred painting
3—2 years of deferred painting
3—2 to 3 years of deferred painting
3—3 to 5 years of deferred painting
1—Yes, but not specified as to years
1—Always some deferred painting
1—Problematical as to years behind

From the nature of the replies and the size of the territory covered by the various roads replying, we believe that the railroads in this country and Canada are at least two years behind in the painting of their steel bridges.

In conclusion, we find the railways of this country and Canada are making every effort to keep their bridges in first class shape. Paint is generally no longer applied at regular intervals of three or four years or always kept up to present a pleasing appearance. Each paint job must now give its limit of service and the need for repainting is judged on absolute necessity.

The standard bridge paints having mineral substances for pigments and boiled linseed oils for vehicles have been so developed and tested by service that under ordinary weather and climatic conditions they will give 4 to 10 years of protection. The largest problem in keeping steel bridges protected is that caused by the action of brine and locomotive gases, which soon break down the paint film and then corrode the steel. Experience has proved that standard bridge paints cannot stand up for any economical length of time under such conditions, and that when renewed, the surfaces involved must be cleaned thoroughly. Ordinary methods, such as brushing, scraping and pounding, will not remove all rust. For example, some of us have seen floor beams, exposed to intensive brine action, which have been given a thorough cleaning with wire brushes and chipping hammers and then primed with red lead and covered with a top coat of mineral paint, start to blister in six months.

Spraying Equipment Will Handle Either Paint or Oil and Is Being Used by Many Roads

Sandblasting will remove all rust and scale down to clean metal. However, this reduces the sections, and cannot be employed economically every time that steel exposed to brine or gas action needs protection. Then, too, more than the readily accessible parts of spans, such as the tops of top flanges of floor beams, need attention. On a through girder span exposed to brine action, the following parts, for example, suffer corrosion: Girders—the tops of outstanding legs of inside bottom flange angles, the web legs of the same angles, and the inside of web plates and stiffener angles, particularly at the bottoms of the outstanding legs. Floor beams—tops, edges and undersides of top flange angles and cover plates, top sides of outstanding legs and web legs of bottom flange angles, webs and gusset plates outside of the rails, particularly on the side from which brine traffic approaches (web above stringers when there is no side plate is rapidly attacked). Stringers—both sides of the outstanding legs of top and bottom flange angles and webs, particularly on the side nearest the rail. Laterals—outside of the rails along stringer connections and lateral plates to girders. To sandblast a through girder span exposed to brine action, with the floor in place and expect every part to be cleaned to bare metal, for example, is out of the question.

Oils or greasy coatings with rust inhibitive substances which can be applied over old scale and rust, if applied regularly, afford maintenance men the best opportunity to keep their bridges in first class condition. It would seem that on lines subject to heavy brine, or in locations where bridge structures are exposed to locomotive gas action, they should prove ideal substances for all metal below the floor in that they can be applied by either spray or brush, without intensive cleaning and without skilled labor. Such coatings can be re-applied oftener at first and less often as the rust coating is reduced. In the case of severe brine exposure on the tops of the top flanges of floor beams and stringers, such coatings are probably best used with more or less permanent coverings, such as asphalt-saturated fabrics, asphalt paints and emulsions or bridge cements.

The use of oils or greasy coatings with rust inhibiting substances on entire structures would not prove economical except in special locations, such as along sea coasts or over salt water, as ordinary bridge paints will give two to three times the life expected from such coatings. Then, too, there is the inspection of the structure to be taken into account, which greasy or oily coatings would make hazardous and disagreeable. Where such substances are used they must not be used where men walk.

The development of rust inhibitors, to be followed by special paint primers and finish coats, is still in the

experimental stage so far as the railways are concerned. Such a development may prove of value, particularly for use on new structures, but how it will stand up under severe brine and engine gas action is still a matter of conjecture. Because of the cleaning necessary to secure a proper surface for such applications on structures already in service under heavy brine conditions, or exposed to the action of locomotive gas, it does not seem that they can compete with the grease or oil-inhibitive coatings.

The maintenance of paint on steel bridges is an ever-pressing problem, increasing as structures get older and as refrigerator traffic becomes heavier. That the maintenance forces represented in this association are always striving to solve this problem is well evidenced by the information we have received from the various roads of this country and Canada.

Committee—R. W. Johnson (chairman), asst. engr., C. M. St. P. & P., Chicago; E. C. Neville (vice-chairman), b. & b. mast., C. N., Toronto, Ont.; R. E. Caudle, asst. engr. struct., M. P., Houston, Tex.; H. Cunniff, gen. foreman painters, D. & H., Cohoes, N.Y.; R. DeArmond, asst. b. & b. supv., S. P., San Francisco, Cal.; M. H. Dick, eastern editor, *Railway Engineering and Maintenance*, New York; J. W. Gannon, b. & b. supv., B. & M., Concord, N.H.; J. E. Hogan, asst. engr., C. & O., Hinton, W. Va.; C. E. Horrom, b. & b. supv., Alton, Bloomington, Ill.; A. S. Krefting, res. engr., M. S. P. & S. S. M., Minneapolis, Minn.; J. J. LaBat, asst. supv. b. & b., M. P., Poplar Bluff, Mo.; W. L. Smith, bridge engr., Terminal Railroad Assoc. of St. Louis, St. Louis, Mo.; J. A. Trombly, gen. b. & b. foreman, N. Y. N. H. & H., Hartford, Conn.; J. L. Varker, b. & b. supv., D. & H., Carbondale, Pa.; B. M. Whitehouse, gen. bridge insp., C. & N. W., Chicago; J. J. Wishart, b. & b. supv., N. Y. N. H. & H., Boston, Mass.

Discussion

After a somewhat detailed discussion of corrosion, it was generally agreed that corrosion is more likely to start first at the rivet heads than elsewhere, and several speakers stated that they now require rivets to be given a priming coat and one or two coats of paint before the remainder of the painting of the structure is done. A. M. Knowles (Erie) said that his experience indicates that field-driven rivets are more severely attacked than shop-driven rivets, and that he is now using a special snap in the hammer to overcome this trouble.

It was also agreed that it is necessary to differentiate between wrought iron and steel, several cases being cited where paint has lasted much longer on wrought iron surfaces than on steel surfaces. In answer to a question as to the effect of deferred painting, S. T. Corey (C. R. I. & P.) cited a case of deferred painting where a reduction of two tons of metal was found in the cover plates alone on a plate girder bridge. Another item given considerable attention was that of the painting of mill scale, several speakers advocating the removal of loose scale and the practice of painting over tight scale without attempting to remove it either with tools or through natural loosening before the paint is applied, saying that paint does not fail if applied at once over tight scale.

The discussion next turned to the use of rust inhibitors and a number of speakers recommended their use, especially on floor systems and points of severe corrosion that are hard to reach. The question arose, however, as to whether a return can be made to lead-and-oil paints after the grease vehicle carrying the rust inhibiting elements has been applied and it was explained that this can be done with a number of materials, although it may take several years before it is possible to go back to the oil paints.

The Use of Preframed Treated Timber for Replacement Purposes

Report of Committee

TO preframe or not to preframe treated timber for replacement purposes is the question that your committee has endeavored to answer, construing the word "replacement" to mean out-of-face renewals, as well as patch repairs. To what extent are such replacements practicable? Is it possible to frame accurately from field measurements or plans? What effect does it have on the quality of work and the speed with which it can be carried out? And is it economically justified?

In an attempt to answer these and other questions relating to the subject with some authority, your committee sought the experience of at least the larger railways of the country, and received detailed answers from 62 roads, including approximately 204,900 miles of lines. As a background for our study, we attempted first to ascertain the practices of these roads with regard to the use of preframed and non-preframed timber for new construction

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and learned that of the 62 roads, 25 make extensive use of treated timber for this purpose, either in whole or in part; 13 of them make what might be termed considerable use of treated timber for new construction, largely in bridges and trestles; 15 make limited use of treated timber for this purpose, confining its use largely to important main-line structures; while 9 make little or no use of treated timber for any class of construction. On those roads where the latter is the case, or where the use of treated timber is strictly limited, a number of reasons have been ascribed, among them being high altitude or other favorable climatic conditions which insure long life for the untreated species of timber employed, and ready accessibility, at relatively low prices, to adequate timber supplies, which condition appears still to prevail in some sections of the country.

Of all of the roads reporting the use of treated timber for new construction, 14 are committed to framing it before treatment, and do this to the largest extent to which they

consider it practicable. Twenty-nine of the roads do relatively little preframing, confining such framing as is done to the sizing of trestle caps and stringers, and in some cases the sizing and dapping of bridge and trestle ties. Ten of the roads reporting the use of treated timber for new construction, extensive or otherwise, state that they do no preframing of this timber whatever.

For Replacement Purposes

With the foregoing background concerning the practices of a large number of roads as regards the use of treated timber, either preframed or not preframed, for new construction, the committee endeavored to determine the extent to which these same roads employ preframed treated timber for replacement purposes. In this regard, the information secured shows that among those roads which are committed to the use of preframed treated timber for new construction, the practice of preframing for replacement purposes is extensive, for both out-of-face renewals and for alterations and patch repairs, although widely varied as to extent between the various roads. Most of the roads reporting that they follow this practice, started it during the last 7 or 8 years, although several roads started prior to 1927, and at least one road, the Louisville & Nashville, began the preframing of the timber used in replacements as early as 1898.

Typical Applications

Typical of the many purposes for which preframed treated material is being used are the following: In bridges and trestles for caps, stringers, guard rails, bents, sills, ties, spacer blocks, bracing, hand rails, fenders, back-walls, walkways, and water-barrel and refuge bays; for water tanks and their supporting frames; for replacements in coaling stations, highway bridges, wharves, piers, docks and lighters; and for the replacement of trunking, capping, scale pit walls and scale decks, sand bins, enginehouse jacking timbers and turntable center blocks and pit wall timbers. A number of roads, in addition, have used pre-sized and cut treated planking for a wide range of platforms, and for platform joists and curbs, and several roads have used pre-sized and cut timber or lumber for foundations, sills, first-floor joists, rafters and sash.

As already stated, the scope and extent to which the various roads have used preframed treated timber for replacement purposes has varied widely. Several roads confine its use to out-of-face renewals. Some use it alone for ties on steel bridges and trestles, and for caps and stringers. Other roads limit its use to those structures for which standard plans are available, while the extent to which others use it depends upon the relative difficulty of securing accurate field measurements, where plans are not available. Again, some presize such pieces as ties, stringers and bracing, but do not pre-bore them, or only partially pre-bore them, and, in most cases, preframed treated timber is used for replacements in treated structures only, and where untreated timber, or second-hand treated timber, if used, would not have a life equal to the remaining life in the structure generally—that is, to carry along until the structure as a whole requires renewal out-of-face.

Wherever possible, the necessary detailed information to insure the accuracy of all preframing work is secured from the original detailed plans of the structure involved. In fact, as already pointed out, some roads confine their replacements with preframed treated timber to those structures for which such plans are available, eliminating the necessity for special, detailed field measurements. On the other hand, many roads find it feasible, where plans are not available, to make the necessary field measurements and sketches, the responsibility for doing this work being placed differently, depending upon the organization on the particular road, and, in some cases, the class or type of structure involved.

On many roads this responsibility is placed upon the division engineering forces, while on others such measurements as are required are secured by bridge and building supervisors, general foreman or inspectors. In many cases where large structures or extensive renewals are involved, the field measurements are secured by special engineering parties from the office of the bridge engineer or chief engineer. Regardless of who makes the measurements, however, the final result is the same—the preparation of sketches or drawings, sufficiently detailed to enable the forces at the preframing plant to frame and designate the pieces required accurately. The importance of this detail of preframing should not be overlooked. On it depends the accuracy of the preframing itself, and if it is not done with the greatest care and precision, much labor is wasted, the pieces themselves may be useless, or much of the value of treatment may be lost by the necessity of correct framing in the field, and installation operations may be delayed, with possible interference with train operation.

Preframing Facilities

Depending upon the policies or equipment of the various roads, the preframing work is carried out at commercial plants, or by company forces in company-owned bridge and building shops or preframing plants. The well-equipped commercial plant is usually able to handle all classes of sizing, framing and boring work, with a capacity far in excess of the requirements of any individual road, and today there are many such well-equipped plants. The preframing equipment owned by the average road varies in extent and character, not so much with the amount of material preframed for alteration or repair work, but more directly with the amount of preframing required for new construction and out-of-face replacements. Obviously, therefore, the equipment available on most of the roads has little direct relation to the amount of timber preframed for replacement purposes. It is of interest to note, however, that the equipment employed by the different roads, depending largely upon the amount of material preframed, varies from a few portable power tools to well-equipped preframing plants, capable of handling all types of work. Several roads, with limited requirements for preframing, indicate that the work is being done with such portable tools as power cut-off and rip saws and power augers, while a number of other roads, in addition to such equipment, have band saws, adzing, boring and dapping machines, trimmers, planers, matchers and gainers.

Whatever the size or relative importance of the preframing shop or plant of a road, it is important that it have adequate power equipment to carry out the operations called for with speed, accuracy and safety. Herein lies one of the advantages of preframing, namely, the speed, accuracy and safety, with economy, that plant preframing, with proper power tools, has over field framing.

Careful Check Necessary

As in the case of making preliminary measurements and the preframing operations themselves, a careful plant inspection of preframed materials before they are shipped to specific jobs is important to prevent incorrectly framed or bored pieces being received in the field. Most roads recognize this, but some ap-

pear to give it more detailed attention than others. On some roads this inspection is left to the plant foreman, while on others, depending upon the extent of the work, it is made by representatives of division or system engineering offices. In not a few cases, the final inspection of all preframed materials rests upon bridge and building supervisors.

Because of the relatively simple preframing required by much of the timber employed for various purposes, the inspection required is relatively simple, involving only the checking of dimensions and the position of holes. On the other hand, where complete decks or bents are involved, for example, a number of roads require a complete test assembly of the material at the preframing plant before it is treated. This added precaution not only insures positive and rapid installation in the field, but in many instances is used to advantage in the framing operations themselves, such as in the case where guard rail bolt holes are bored in both the guard timbers and deck ties while the guard timbers lay in their final positions during the test assembly. With such precautions, it is rare that misfit pieces arrive on the job. In fact, many instances are on record of extensive renewal projects with preframed treated timber, involving thousands of individual timbers, where not a single field cut or field-bored hole was necessary.

For the purpose of designating the location of specific pieces in any structure or structures, it is the common practice to apply designating numbers or letters to the ends of individual pieces as they are framed, these characters corresponding with piece designations on the erection plans or sketches, and frequently being expanded to indicate the division or requisition involved. On some roads these identifying characters are stamped in the ends of the various pieces by dies, while a considerable number of other roads employ stamped metal tags nailed in place.

Regardless of the extent to which they carry out preframing, most roads find it necessary, if only infrequently, to make certain cuts and holes in the field. Where this necessity arises it is invariably the practice to afford some protection to any new or partially treated wood exposed, although the practice on some roads appears to be more thorough and effective than that employed on others. For example, whereas some roads require that all field-cut faces be swabbed with hot creosote oil, others require that the application of creosote be followed by one or more applications or coal-tar pitch. Likewise, in the case of field-bored holes, some roads still feel that it is sufficient to swab the holes with creosote, or a combination of creosote and pitch, while most roads appear to have given up this practice in favor of a creosote pressure treatment with a specially designed pressure gun, which is obviously more effective. In addition, some roads dip all bolts in pitch during field erection, applying a liberal amount of this material beneath the washers as a further seal against the penetration of moisture.

Advantages

In those cases where it has been determined to be economical to use treated material for out-of-face replacements or for alteration and repair work, there are definite advantages through preframing this material. The more important of these can be listed as follows: Increases the life of the timber by insuring the maximum depth of treatment on all exposed surfaces, thus guarding against partial destruction by decay or by attack by termites or other wood-boring insects; insures the maximum return upon the investment in the timber and its preservative treatment; insures better workmanship and more accurate fit if properly done; is faster and more economical than field framing; reduces the time required for erection or installation, which affects costs favorably and may prevent delays to traffic; permits the employment of a less skilled field force; minimizes the frequency of renewals, with corresponding savings in labor costs; and insures the greatest salvage value of the material in the event it is released from a structure in subsequent dismantling or out-of-face renewal operations.

The following have been cited by various roads as disadvantages inherent in preframing treated timber for replacement purposes: The expense, time and often difficulty in obtaining adequate and accurate field measurements, and in making plans; the long interval between the decision to make replacements and the actual work, necessitated by the time required to secure measurements and to preframe and treat; the possibility of misfits, requiring field cuts or boring in any event, defeating the purpose of the plant preframing, and sometimes causing waste; and low salvage value for this material if released, which, if not a standard piece, would require reframing for further use.

In addition to these alleged disadvantages, one road, without preframing facilities of its own, suggests that competitive bids for preframed material are necessarily limited to treating companies equipped to do preframing, and another road fears that a policy calling for repairs with preframed material would tend to reward the retention of obsolete standards and bad details that would otherwise be corrected or brought up to date. For still another road, the necessity for double handling and haul over foreign lines is a disadvantage.

The committee has taken full cognizance of the foregoing opinions, and, while it is fully aware that preframing presents some added difficulties in some cases, is not readily applicable to every situation, and may cost more under some circumstances, it agrees with the proponents of this practice—that where it is found desirable and economical to use treated timber for replacement purposes, the added initial trouble, and the added initial cost, if any, in preframing this timber, is justified in most cases and, more frequently than not, will be offset by the advantages of greater life of the timber, better workmanship, faster installation and cheaper erection cost, together with other of the advantages listed in the foregoing.

In its general agreement with the practice of preframing, the committee reflects the favorable experience in this regard of many of its members, and is not unmindful of the fact that whereas most of the advantages listed in the foregoing were cited by roads with long experience in preframing, most of the alleged disadvantages pointed out were cited by roads which have done little or no preframing.

Must Analyze Each Case

Your committee, in common with many roads, feels that there is often greater justification for using preframing treated material for out-of-face replacements than for isolated replacements in alteration or repair work. Whether it is practicable to employ preframed treated timber for piecemeal replacements in many cases, and, in fact, whether it is practicable to employ new treated material at all for such replacements, is a matter for special study in each particular case. The point which your committee stresses is that if treated material is to be used for such replacements, the most careful consideration should be given to the advantages of preframing it, to insure the greatest return upon the investment in the timber and the treatment, either within the structure re-

paired, or subsequenly when the structure is renewed out-of-face, and the released material is salvaged.

Out of Face or Spot Renewals?

On the basis that there comes a time when it becomes more economical to renew most timber structures out-of-face, or at least sectionally, than to patch and repair them repeatedly, the question arises as to the point in the life of any structure beyond which it is uneconomical to continue to patch and repair with material that will have a longer life than the remaining life of the structure as a whole. For example, in the case of the premature decay or destruction of one or more pieces in a preframed treated structure less than 10 years old, with an expected remaining life of 20 to 30 years, few, it would seem, would question the advisability or economy of making replacements with new treated timber, possibly preframed, because to use untreated timber, or perhaps second-hand treated timber, with a life less than the remaining life in the structure as a whole, would require the subsequent replacement of this timber at a later date, prior to the time at which it becomes necessary to renew the structure out-of-face.

On the other hand, assuming the need for similar replacements in the same structure after it is 30 years or more old, it may be more economical to use second-hand treated material, if available, or even untreated material, for replacements, rather than new preframed treated material. Some roads keep a stock of second-hand treated material on hand for just such purposes—and where it will fill out the life of the structure satisfactorily, it would appear advantageous to use this material rather than new preframed treated material with a projected life far beyond that of the structure as a whole.

Great Accuracy of Work and Careful Checking Against Measurements or Plans Are Essential to Successful Preframing

This same reasoning does not apply to parts of structures which normally have a relatively short life as compared with the structure as a whole, such as trestle caps and sills, and parts of buildings in contact with or near the ground. Neither does it apply to those parts of structures which are particularly susceptible to the attack of termites or other wood-boring insects, nor to individual structural timbers used separately, and seldom, if ever, replaced out-of-face. In these cases, we feel that treated timber should be used, unless for some special justifying circumstance, and that to secure the greatest return upon the investment made in the timber and treatment, it should be preframed.

Conclusion

Long experience by many roads has shown that, in most instances, it is entirely practicable to preframe treated material for replacement purpose—that, properly supervised, errors need not and seldom occur, and that, in the long run, through greater service life of the timber, more accurate fit, more economical framing costs and increased speed of installation, preframed treated timber is more satisfactory and more economical than treated timber framed in the field. It is our recommendation, therefore, that increased consideration be given to this practice, to the end that the highest grade of workmanship and the largest possible economies will be effected in railway bridge and building work.

Committee—N. D. Howard (chairman), managing editor, *Railway Engineering and Maintenance*, Chicago; H. M. Church (vice-chairman), gen. supv. b. & b., C. & O., Richmond, Va.; W. A. Batey, sys. bridge insp., U. P., Omaha, Neb.; L. G. Byrd, supv. b. & b., M. P. Poplar Bluff, Mo.; A. B. Chapman, office engr., C. M. St. P. & P., Chicago; W. R. Edwards, gen. bridge insp., B. & O., Baltimore, Md.; L. D. Garis, asst. gen. bridge insp., C. & N. W., Chicago; W. B. MacKenzie, asst. bridge engr., St. L.-S. F., Springfield, Mo.; John McCaffery, asst. gen. bridge insp., S. P., San Francisco, Cal.; J. H. McClure, b. & b. mast., C. N., Moncton, N. B.; W. Pelham, main. insp., Erie, Youngstown, Ohio; G. A. Rodman, gen. supv. b. & b., N. Y. N. H. & H., New Haven, Conn.; G. L. Sitton, ch. engr., m. of w. and s., Sou., Charlotte, N.C.; and T. E. Snyder, bridge and building supervisor, B. & O., Salamanca, N.Y.

Discussion

R. D. Ransom (C. & N. W.) recommended that plans be developed that will require the least amount of preframing for pieces intended for piecemeal repairs. If this is done, he suggested, a stock of repair timbers can be kept on hand for quick use when needed. President Chinn agreed that simplification in framing would increase the use of preframed timber, stating that there is no reason why preframing cannot be done with the same accuracy as the fabrication of members for steel bridges.

Chairman Howard stated that the returns received in reply to the committee's questionnaire indicated that more roads are adopting standards of bridge and trestle details, and where this is done, a stock of the preframed members can be kept on hand for renewal. H. M. Church (C. & O.) observed that the roads as a whole are not doing as good a job with respect to preframing as had been hoped, and said that his road had found the use of preframed treated timber in many buildings practicable, including certain piers and docks involving somewhat complicated designs. Continuing, he said that one of the special advantages in the use of preframed treated material was that it permits the use of lower grades of lumber and timber, because timbers with a large amount of sapwood will take the treatment better than those containing a large percentage of heartwood. He also explained the system of standard plans and erection plans in use for timber trestles on the C. & O., and, in answer to a question from the floor, replied that it is the practice on his road to preframe all bracing for trestles, including the boring of the holes, and that few misfits occur. Recently, he said, timbers have been preframed to permit the use of timber connectors of the split-ring type.

The discussion then turned to methods of obtaining the data required for preframing where structures are not in accordance with standard plans; with respect to fitting ties on deck girders where the rivet heads protrude; and other details in connection with the application of preframed treated decks.

Pumping Equipment to Meet Today's Requirements

Report of Committee

M. P. Walden
Chairman

THE water supply, the power sources available, and the demand for water are the paramount questions involved in the selection of the most economical and efficient pumping equipment for any specific location. In selecting the power for pump operation, one should, of course, analyze its cost, availability and dependability. Electricity, gasoline, fuel oil and steam have their particular advantages for either automatic or manually-operated pumping plants. In determining which to employ, consideration must be given to the relative availability of coal and rural electric power lines with their attractive rates. Cheap fuel and convenient handling at many points justify the use of steam pumping plants, especially where there is joint operation of two stations or where it is possible to reduce labor costs by giving the pumper other duties.

After a complete survey of all of the conditions mentioned above, a careful study should be made of the present and probable future water requirements (plus 20 to 30 per cent reserve capacity), and single or duplicate units should be provided, depending upon the importance of the plant. In determining the capacity of any plant, it is important to provide capacity for probable increased demands and to compensate for the decreased efficiency of the plant with service and wear.

The need for pumping equipment has been eliminated at many points on the railways in recent years, while demands have increased at other points. One road reports that of a total of more than 400 water stations in service 25 years ago, more than 100 have been retired; that approximately 140 stations have been remodeled and enlarged; that oil engines have been installed at approximately 60 points, and that automatically-controlled electric pumps have been installed at 50 other points. Furthermore, it reports that water treatment has been extended to include 123 water stations, which now treat 3,225,000,000 gal. of water annually. Such changes and improvements in water station facilities have been necessitated by changes in operating conditions and increasing demands, as well as to obtain greater economy in operation and maintenance.

Water stations have also been affected seriously by the use of larger engine tanks, permitting longer runs between water stops, and by the speeding up of train schedules, which permits greater spacing between stations. At the same time, these larger tanks take more water from those stations at which they stop, requiring an increase in the capacity of the pumping equipment and warranting the installation of more modern and efficient pumping equipment.

A major feature to be considered in providing pumping equipment to meet present-day demands is that of insuring adequate storage facilities to permit the pumping of each day's water requirements within a period that will avoid excessive expense in overtime attendance. Another important consideration is the time required to deliver water to locomotives. Many, if not a majority of the water stations and facilities for delivering water to locomotives were constructed at a time when locomotive tenders had capacities ranging from 5,000 to 7,500 gal., and rarely exceeding 10,000 gal., while today a tender with a capacity of 9,000 to 10,000 gal, is considered small and many roads have tenders with capacities exceeding 20,000 gal.

Electrically-driven centrifugal pumps (the turbine-type for wells and the horizontal type for surface water) are producing better results than reciprocating-type pumps, and are effecting considerable savings in operating costs. One road which replaced steam plants with electric plants at three of its large pumping stations reports that at one of these points the total operating and repair costs of its old steam plant for one year were $8,244, as compared with a total cost of only $1,980 a year for the automatic, electrically-operated plant which replaced it—a net annual saving of $6,264. At a second station, the annual operating cost of the old steam plant was $3,075.95, as compared with a total cost of only $630 for the automatic electric plant which replaced it, an annual saving of $2,445.95. At the third station, the annual operating cost of $2,715.32 for the steam plant was cut to $680 for the automatic electric plant, effecting an annual net saving of $2,035.32. The replacement of the steam pumps and boilers at these three stations by automatic electric-driven pumps is typical of many improved plants to be found on various railways, and illustrates the savings that can be made by the substitution of modern efficient pumping equipment for older equipment which has become obsolete.

Pumping equipment is an expensive and important part of railroad properties, and requires practical, experienced employees to operate it effectively and economically. From the information available, it is evident that the trend is toward the use of semi-diesel engines and electrically-driven horizontal centrifugal, vertical centrifugal or deep well turbine pumps, which types operate successfully and economically against heads as great as 400 ft.

Possibilities for Improvement

As an illustration of the possibilities still available for improving water stations, we submit as Fig. 1 a view of a steam pumping plant serving two roads as a joint pumping station. The equipment here is of an old type but it is simple and reliable in operation. This station is located on the bank of a small river. The pump, a 10-in. by 7-in. by 12-in. duplex, is mounted on a frame with wheels and is pulled up or let down an incline track as the water rises or recedes in the river, to keep it within surface pumping limits. The pump is housed to protect it against freezing weather as well as from pilferage. Flanged pipe connections are provided in both the suction and discharge lines, so that when

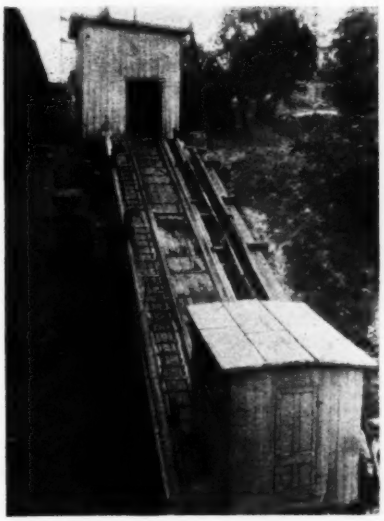


Fig. 1—This Plant Presents Opportunities for More Economical Operation

it becomes necessary to move the pump, this can be done readily. The pump and its housing are pulled up and lowered by a hand-operated crab or windlass with steel cable, and suitable chain anchors are provided at the different locations to hold them rigidly in position while in operation. The short section of open-deck trestle shown is used exclusively for the unloading of coal for the steam pump, this being done at no expense other than to open the drop doors of the coal car. The annual operating cost of this station is:

Maintenance	$ 486.50
Operation	1,750.20
Total	$2,236.70

This station is attended by one pumper, who averages a nine-hour day.

From the above figures it appears that this station is being operated with reasonable economy, but, on the other hand, considering the entire investment involved, including that for the unloading trestle, the pump house on wheels, the incline and the track, the boiler house, etc., it seems to present a typical set-up wherein sizable savings could be made for the two roads involved through the installation of modern equipment. For this plant, we suggest an automatic electric installation, with a centrifugal turbine-type pump, and with a well sunk near the bridge pier, where the pump house could be supported on piling above high water. As an alternate for this arrangement, we suggest a walled-up pump well of sufficient size to permit the installation of a horizontal-type centrifugal pump in the bottom of the well. We believe that either type of installation would reduce operating and maintenance costs one half.

Figure 2 shows a deep-well pump house equipped with an electric motor-driven turbine pump which serves a yard terminal. This plant is operated automatically, requiring an attendant only to lubricate the exposed parts of the pump. The well is about 400 ft. deep and the drop pipe and impellers are pulled for inspection every two years. For this latter purpose, a tower is provided, equipped with a separate motor-operated hoist with steel cable. This arrangement reduces the time and cost of pulling the pipe and impellers to a minimum and requires that the plant be out of service for only a few hours. The cost of operating this plant is well within the range produced by best economical practices. We have no accurate figures relative to the daily consumption of water at this plant or the monthly cost for power, but we are advised that the operation is highly economical; that the plant requires minimum attention; and that it has been operated successfully for the last several years at a satisfactory saving over the steam-driven deep-well pump formerly in service.

Certain eastern roads have been using track pans for many years for watering engines "on the run" in heavy traffic territory. However, the high first cost and the high maintenance costs of these pans are inviting the use of engine tender tanks with large water carrying capacity, which make possible long runs without stops for water except at terminals where water servicing can be had without loss of time. The effect of large engine tenders on present-day water service is well presented in the proceedings of the association for 1937. However, it is referred to here as one of the factors making unnecessary a large number of line water stations, and requiring the provision of larger storage facilities and larger capacity pumps at a few locations to take care of the increased demand.

Fig. 2—A Modern Plant, Equipped With a Motor-Driven Turbine Pump

Some roads which have many engine tenders of not more than 10,000 to 12,000 gal. capacity are using two such tenders (double-tanking) on through freight runs to avoid frequent stops for water and speed up schedules. This practice, of course, affects pumping facilities at terminals or where water must be supplied.

According to the Interstate Commerce Commission, expenditures made by the Class I railroads in 1936 included $5,860,164 for the maintenance of water stations, $15,900,521 for water for train locomotives, and $3,326,531 for water for yard locomotives—a total of $25,087,216. These large figures, even in a period of slackened activity, show the importance of water service on the railways.

Committee—M. P. Walden (chairman), asst. supv. b. & b., L. & N., Evansville, Ind.; A. C. Sachs (vice-chairman), gen. foreman w. s., C. N., London, Ont.; F. W. Allen, gen electric foreman, N. Y. C., Albany, N. Y.; R. C. Bardwell, supt. water supply, C. & O., Richmond, Va.; R. T. Burns, supv. water service, C. & N. W., Boone, Ia.; John Cole, foreman water service, C. N., Toronto, Ont.; L. A. Cowsert, water insp., B. & O., Dayton, Ohio; V. E. Engman, ch. carp., C. M., St. P. & P., Savanna, Ill.; H. H. Frisbie, div. gen. water supv. formean, C. & N. W., Sioux City, Ia.; Theo. Gunter, supv. water service, M. P., St. Louis, Mo.; H. A. Horning, supt. bldgs., M. C., Jackson, Mich.; B. J. Howay, b. & b. supv., P. M., Grand Ledge, Mich.; H. G. Johnson, draftsman, C. M. St. P. & P., Chicago; C. R. Knowles, supt. water service, I. C., Chicago; Garry Smith, foreman water service, N. Y. C., Rochester, N.Y.; W. L. Wallace, supervisor water service, P. M., Saginaw, Michigan.

Discussion

R. C. Bardwell (C. & O.) called special attention to the examples of economies cited in the report as the result of the installation of modern pumping equipment and emphasized that while these may appear small in themselves, they are large in the aggregate when a railroad as a whole is concerned. Substantiating this statement, he cited the example of a road that since 1923 had reduced the number of its water stations from 225 to 175, in spite of increased traffic and tonnage handled, and its annual water station costs during the same period from more than $750,000 to less than $500,000.

C. R. Knowles (I. C.) spoke of the important developments in deep-well pumping equipment in recent years, and then cited an example of the re-

placement of an old steam plant at Paxton, Ill., with three 10-in. wells, by an automatic electric pumping plant in a new location, which reduced pumping costs from $0.18 per 1,000 gal. to $0.06 per 1,000 gal.

President Chinn pointed out that a number of automatically-operated electric pumping plants had been installed on the Alton, but said that others had been held up by high electric rates. Then, without results, he called for any information available relative to automatically-operated gasoline or oil-engine pumping equipment. Turning momentarily to the subject of water treatment, Chairman Walden said that as the result of water treatment on six divisions on the L. & N., they were effecting an annual saving of more than $250,000.

Again changing the subject, B. R. Meyers (C. & N. W.) suggested the advisability, when confronted with the problem of rebuilding water facilities, of considering the use of any city water supply available, especially where large plant overhead costs would be involved. Mr. Knowles agreed with this suggestion, and said that the question of plant vs. city water is one which must be considered for each point individually, on the basis of local conditions, not overlooking the quality of the city water which it is contemplated using.

Glazing Maintenance in Shops and Enginehouses

Report of Committee

F. H. Soothill
Chairman

MANY factors enter into the consideration of glazing maintenance. Undoubtedly, the most important factor in the proper maintenance of wood windows and doors is the application of paint at regular intervals to prevent moisture from entering the construction joints. With the entrance of moisture into wood sash, the alternate wetting and drying out processes hasten decay and loosen the rails, stiles and muntin bars. Sashes so affected have no stability. When an attempt is made to raise or lower them, the putty and glazier's points become displaced, and eventually glass breakage results. The application of paint is probably more important to the preservation of steel and sheet metal sash than to wood sash, especially around shops and enginehouses, for the reason that metal in such locations is subjected not alone to the action of ordinary rust, but to attack by sulphurous gases as well.

Treated Wood Sash

While the subject of our assignment would not indicate our primary concern with the construction of window sash, which is a millwork item, the subject of glazing is so closely related with sash construction that it is impossible to discuss one without touching upon the other. A number of roads have devoted considerable study to the methods best adapted to overcome the destructive action of smoke, vapors and moisture on wood sash used at engine terminals and in shop buildings, with the result that some have adopted creosote treatment. The method employed by one railroad for new sash construction is as follows:

The material for the window frames is cut to size before treatment, but is not assembled. The sashes are framed and pinned together loosely with wood dowels before treatment and then fastened together securely after treatment. All wood is treated by the empty-cell process, with a final retention of 6 lb. of Grade 1 coal-tar creosote per cubic foot. The glass is held in place by treated wood beads fastened in place with copper nails, no paint or putty being used. Except as a temporary measure, this method of stopping in glass is not recommended for untreated sash, as it will accelerate decay. All of the windows in several buildings of a large engine terminal in the central west were installed in accordance with the foregoing specifications, in 1926, and since that time no maintenance has been required on these windows, except the replacement of glass broken accidentally.

A southern railroad has employed creosoted sash in shop and engine terminal buildings for the last 14 years with complete success. This road uses ordinary putty for glazing, with the addition of a small amount of coloring material. If the sashes are to be used in an office, or in any other room the interior of which is to be painted, a coat of shellac is applied to the wood after treatment, and the sashes are then painted to conform with the color scheme desired.

An eastern road completely assembles its sashes, including the fitting and placing of wood glazing beads, before treatment. Following pressure treatment, the wood beads are removed, the glass is installed, and the beads are replaced. Experience has shown that this method is effective and that the treatment thoroughly penetrates all joints.

Treated millwork is now available throughout the United States through leading manufacturers at very little, if any, increase in cost over untreated millwork. In railroad buildings of certain types, therefore, where it is known from experience that sash and woodwork will be subject to decay or termite attack by reason of service conditions, favorable consideration should be given to the use of treated millwork in the interest of economy.

Types of Glass

For the purpose of this report, glass is classified as follows:

- Window glass
  - Single strength (10 to 11½ lights per inch)
  - Double strength (7½ to 8 lights per inch)
  - "A" quality
  - "B" quality
- Obscure glass
  - Rough pattern
  - Smooth pattern
  - Heat absorbing
- Wire glass
  - Rough pattern
  - Smooth pattern

Where clear glass is required, "B" quality glass is a second selection, selling for less than "A," or first

quality. The allowable imperfections in "B" quality glass are not such as to prevent its use for shops and engine-houses. While single-strength glass is less expensive than double-strength glass, the labor cost involved in the glazing is the same. For wood sash divided into lights not exceeding 12 in. by 24 in., single-strength glass will prove satisfactory. For sizes larger than the foregoing, double-strength glass is recommended. From the standpoint of economy, it is recommended that steel sash be glazed with double-strength glass. In instances where service conditions are unusually severe, the advisability of using ¼-in. wire glass is suggested.

Some window glass is more brittle than others as the result of differences in annealing or tempering. Frequently, this undesirable feature is noticed when cutting glass to size, as brittle glass sometimes breaks the wrong way. In the interest of keeping down glass breakage resulting from cutting, therefore, foremen should watch the cutting qualities of various brands of glass and should report those in which breakage appears to be excessively high.

All broken pieces of serviceable double-strength "A" glass removed from sash should be cut to smaller sizes and reused where repairs are needed. If this practice is followed, considerable saving should be realized in the purchase of new glass.

Obscure glass is made in ⅛ in., 3/16 in. and ¼ in. thicknesses and is generally used in toilet and locker rooms. In this type of glass there are various "patterns" which break up the vision and make it obscure. The several patterns available have various percentages of light transmission, ranging from 50 to 90 per cent (an open window affords 100 per cent light transmission), and for new clear window or plate glass up to about 91 to 92 per cent transmission. Ribs or pyramids in glass change the direction of the light materially, and also bring about increased reflection, thereby reducing the percentage of light transmission. Ribs, prisms, pyramids or other very rough surfaces on obscure glass collect dirt quickly and make such glass hard to clean. Where obscure glass is used, it is well to select a glass which has no sharp or deep indentations on its surface.

Wire Glass

Wire glass of ¼-in. thickness is made in many patterns, while in thicknesses of ⅜ in. and ½ in. it is made in only a few patterns. It is also produced with polished (plate glass) surfaces. Wire glass is used mostly in skylights, although, in some instances, it is required by ordinance in fire escape exit doors and windows. As a rule, the ordinance requirements of most cities call for the use of Underwriters' approved sash or doors glazed with ¼-in. obscure wire glass. In all types of wire glass, the wire should be well centered, and the glass itself should be relatively free from seeds or bubbles around the wire.

As to the patterns to be used, care should be exercised to select a surface finish that will facilitate cleaning. Where a distinct pattern is used (except in skylights), the smooth side of the glass should be set facing the greater exposure to dirt.

In all instances, skylight glass should be of a ribbed-wire pattern to avoid its falling if cracks or breaks occur. When placed in skylights, the ribbed side of the glass should be toward the interior of the building, with the ribs parallel with the slope of the skylight, thus providing for the proper conductance of condensation to the skylight gutters. The breakage of skylight glass, in the majority of cases, is due to insufficient clearance between the glass and the frames to allow for expansion. Therefore, all lights of glass used in skylights should be ¼ in. less in width and length than the openings in which they are placed.

Glass is now produced which reduces materially the transmission of solar heat. It is made in "hammered" and "ribbed" patterns, ⅛ in. and ¼ in. in thickness. The ¼-in. thickness is also supplied in wire glass.

Glazing

Putty for wood sash should be obtained from a reliable manufacturer. Being a comparatively cheap item in relation to the cost of the labor for its application, the best quality of material is eventually the least expensive. Too often putty is purchased in competition for a price, with the result that a material is obtained which consists largely of fish oil and marble dust (the latter being added to increase the weight of the compound, which is purchased by the pound). The fish oil is absorbed quickly by the wood in the sash or decomposed by the elements, leaving nothing to bind the mixture, which soon drops off. Supervisory forces should be quick to detect this kind of material and reject it in the interest of economy. A high grade putty should contain 13 to 15 per cent of boiled linseed oil by gross weight and 85 to 87 per cent of whiting (of which 50 per cent should be imported and 50 per cent domestic). An admixture of 1 to 5 per cent of white lead further improves the grade of putty.

When reglazing sash, the workman should remove the old putty down to the wood, preferably by the use of a flat chisel ¾ in. to 1 in. wide. After the putty has been removed, the glass rabbet should receive a priming coat of boiled linseed oil and the glass should be set bedded in putty and sprigged with zinc glaziers' points, after which the exterior putty bead should be applied by means of a putty knife or scraper. Pressure on the knife is necessary to force the putty firmly and smoothly in place.

The procedure with new sash is practically the same. Sash should not be primed or puttied over damp, dusty or icy surfaces. If moisture or dirt is present, the sash should be dried and then cleaned with a cloth or duster before the application of the putty. Putty should not be applied when the temperature is below 40 deg. or on damp or rainy days. Bedding the glass is essential to overcome any unevenness in the sash. Where this is not done, there is a tendency for water to seep through the bottom check rail, causing the putty to fall off. Paint should be applied within one to three weeks after glazing, and the paint should seal the glass and putty, extending up on the glass at least 1/32 in. It is essential to paint putty in order to avoid its deterioration.

With the advent of steel sash in modern industry there came a demand for a glazing material that would retain a softer body indefinitely, provide some degree of elasticity in the bond between the sash and the glass, and permit slight deformation in the pane of glass, but not to the extent that the glass would be broken or cracked. Up to the time that glazing mastics were introduced, there had always been complaints from maintenance men about the difficulty encountered in chiseling out the hard putty when reglazing broken glass—a comparatively expensive labor item in glazing work. A product such as a standard putty, containing in some cases as low as 13 per cent of oil, must, of necessity, become firm and hard, and in many cases brittle. In contrast, a good grade of glazing mastic, having a liquid content as high as 35 to 40 per cent when properly formulated, will tend to develop a thin skin over the surface and to retain a soft, elastic underbody indefinitely.

Knife glazing is carried out by the use of a rigid or stiff putty knife, the glazer bearing down well when applying the mastic and finishing off with a quick, light stroke. Since the perfection of the calking gun, glazing can be carried out economically and more satisfactorily with any one of a number of high grade glazing mastics than with putty. Black glazing mastics, which are lower in price

than glazing mastics in color, are in most instances satisfactory for shop and enginehouse use. Although glazing mastics are higher in cost than the best grade of putty, the difference in cost will be offset fully through the saving in labor expense if the application is made by the gun method. There will be a further saving when it becomes necessary to reglaze broken glass, as it takes considerably less time to remove glazing mastic than ordinary putty.

The glazing mastics referred to are recommended highly for setting skylight glass by reason of their greater resilience and resistance to drying out. The application of such mastic in skylights should be done by hand, with ample material used to provide a good cushion under the glass. If the glazing operation is carried out properly, the cause of considerable glass breakage will be eliminated.

With Proper Construction and Glazing Methods Much Glass Breakage Can Be Avoided

Co-operation Necessary

While there is no doubt that glass breakage can be reduced considerably through greater co-operation between building and mechanical department forces, it is the belief that the average shopman is careful of window glass and is interested in keeping it intact, realizing that properly glazed windows insure him better working conditions, particularly during cold or inclement weather. Inquiry of mechanical department forces indicates that some breakage of glass in shops and enginehouses occurs during window-washing operations. In many cases, loose glass falls out of the sash when pressure is applied with long-handle washing brushes, or when water, under pressure, is used through a hose. Where trouble of this kind is encountered the remedy is, of course, the application of new glazier's points and putty.

Building department forces find occasionally that excessive glass breakage is experienced in enginehouses as the result of the practice of cleaning windows by the use of hose connections from boiler washout lines. The water pressure on these lines averages from 100 to 110 lb. and, when used in window-washing operations, is sufficient to break not only the window glass but the muntin bars as well. The practice of using water from boiler washout lines for washing windows should not be permitted under any circumstances.

One railroad reports that the vibration in some of its enginehouses is so great when locomotives are being drafted or are about ready to pop off, that window panes are continually being broken. This particular instance illustrates the need for closer co-operation between the mechanical and building department forces, as the vibration complained of could be eliminated by filling the hole existing in the fire bed of the locomotive firebox with coal or by cracking the door of the firebox slightly, or both. Mechanical department forces agree that there is no excuse for permitting this condition to exist, particularly if damage is being done to a building.

Install Protective Screens

In shop buildings where machine or blacksmith operations are carried on, it is suggested that excessive glass breakage can be avoided by applying metal screen of small mesh over windows to protect the glass from flying objects. In this connection, however, it should be realized that under circumstances which cause or permit flying objects in or around buildings, a serious hazard to the safety of men exists, and definite steps should be taken immediately to correct such conditions.

One railroad reports that in some of its larger shops and enginehouses breakage was excessively high in the two bottom rows of glass because mechanical department employees were not sufficiently careful when laying tools, small repair parts, etc., along the sills of the windows. The breakage was reduced to a considerable extent by placing a board 8 in. high between the window jambs. Such an arrangement, however, has the disadvantage of reducing the amount of light transmitted.

Other Considerations

Whenever possible, windows in large shop buildings should be equipped with mechanical devices for opening and closing the sash. Such equipment should preferably be operated electrically. Machines that have a tendency to vibrate or to produce an impact should be installed upon supports independent of the building foundations. The careful handling of materials in long lengths by mechanical or store department forces will tend to reduce glass breakage to a considerable extent.

Many supervisors of bridges and buildings find that good results are obtained by pointing out to mechanical department foremen the cause of glass breakage when making periodical inspections of buildings. The best results are obtained by personal contact in such matters, rather than by writing letters. One road offers the suggestion that for certain doors and windows where glass breakage appears to be excessive, a sign 8 in. by 10 in. in size be posted, reading as follows:

Cost to replace glass in this window (door).....$.....
Help us keep down the cost of glass renewal

Enginehouse doors, glazed or otherwise, should be kept tight on their hinges, with sag rods in tension and keepers in proper repair. The mechanical department forces should be requested to see that doors are properly latched when either open or closed. Much glass breakage results when doors slam in the wind or are struck by locomotives passing in or out of enginehouses. Ventilating or swing sashes, together with their operating mechanisms, should be well maintained so that they work freely without undue strain on the sash and glass.

Committee—F. H. Soothill (chairman), ch. est., I. C., Chicago; L. P. Kimball (vice-chairman) engr. bldgs., B. & O., Baltimore, Md.; Chas. Ettinger (second vice-chairman), ret. painter foreman, I. C., Chicago; L. R. Garman, b. & b. insp., Penna., Cleveland, Ohio; A. M. Glander, ch. carp., C. M. St. P. & P., Mason City, Ia.; P. L. Koehler, asst. div. engr., C. & O., Russell, Ky.; W. J. Strout, asst. engr., Bang. & Aroos., Houlton, Me.; E. E. Tanner, gen.

supv. b. & b., N. Y. C., New York; and G. P. Walker, bridge and building supervisor, Mo. Pac., Monroe, Louisiana.

Discussion

Opening the discussion, H. M. Church (C. & O.) told of the extended experience of his road with creosoted sash for shops and enginehouses, in which the sash is generally assembled before treatment, either as a whole, or where too large, sectionally. In this practice they had found thorough penetration of the creosote at all joints, with a resulting product which far outlasted untreated sash, and at small additional cost. He said that his road was also experimenting with the salt treatment of sash.

To a question raised by President Chinn relative to the shrinkage or swelling of treated sash, Mr. Church answered that they had experienced no difficulty in this regard. To another question relative to the means of holding glass in position in creosoted sash, Mr. Church said that they used treated beads, but that tar-base compounds are available which will adhere to the treated wood. President Chinn asked concerning the tightness of glass stopped in with wood beads and as to the best nails to use. To the former question, Chairman Soothill said that beads had been used extensively on the Illinois Central with no difficulty from the infiltration of air or water. To the second question, Mr. Church seconded the recommendation of the committee that copper nails should be used. Continuing, Mr. Church recommended consideration of the Western Pine Association's specifications for sash treatment, which he said were being adopted by many manufacturers.

Relative to the comparative life of treated sash, Chairman Soothill cited an example of untreated sash in an enginehouse which required complete replacement after 13 years, whereas treated sash in the same house, with the same life, was still in perfect condition. President Chinn then spoke of the possibilities of eliminating sash, especially skylights, where not needed by shop and enginehouse forces, as an economy measure, but agreed, on the suggestion of Chairman Soothill, that this should be done only with the consent and co-operation of the mechanical department forces.

Present-Day Methods of Safeguarding Bridge Structures

Report of Committee

E. C. Neville
Chairman

PRESENT-day methods of safeguarding bridge substructures vary, of course, with special conditions, the type of structure and the nature of the work or defects involved, and as a whole, are governed to a large extent by the funds available. All roads have felt the necessity during the last few years of limiting this class of work within the limits dictated by their financial condition, without actually going beyond a reasonable margin of safety, but as the result of the large amount of damage to railroad structures in recent years caused by floods in various sections of the country, the safeguarding of bridge substructures has become a matter of concern.

Financial Conditions a Factor

Realizing the importance of this class of work, as well as the varied conditions and difficulties usually encountered in carrying it out, your committee contacted as many roads as possible in an effort to obtain their views and experiences. The replies received indicate that financial conditions have been the main factor in compelling them to resort in many cases to means not usually prescribed under more normal circumstances as the most permanent methods of safeguarding their structures, but which would preserve them in a safe condition for a reasonable length of time. It is felt, therefore, that the lessons learned by both engineering and bridge and building officers, because of adverse financial conditions, have been beneficial in that they required these men to devise ways and means of repairing and safeguarding structures economically, frequently prolonging the life of structures that would otherwise have had to be renewed, with substantial savings to their companies.

Inspection Important

One of the most essential factors to be considered in making structures safe is frequent and thorough inspection. This work requires a practical knowledge of the various types of construction involved in order to be able to determine the possible cause and probable subsequent result of whatever defects may be discovered.

Decay, settlement and undermining are conditions sometimes encountered in pile or frame trestles, any of which may lead to disaster if not detected and overcome immediately. Decay may develop either above or below the ground line, especially in structures built of untreated timber. It should be looked for at all bearing points where moisture is likely to enter, such as the bearing points of caps on posts or piles, the connections of posts and sills, or the sills and the blocking below the sills. Where no decay is apparent, it is the usual practice to bore into the timbers at these points to discover if the timbers are sound throughout.

Where no exterior decay is observed in piling, it should not be taken for granted that the pile is sound. Instead, the pile should be sounded with a hammer to discover if it is hollow. If there is any doubt as to the soundness of a pile, it should be tested by boring. Excavation should be made around the piles a little below ground level to permit proper inspection.

In cases where repairs are necessary because of decay in the tops of piles or posts directly beneath the cap, it is often sufficient to cut off their tops and to put on a double cap, but where decay takes place at the bottom, it is usually necessary to splice them or to renew them. When

splicing, it should be remembered that not more than two splices should be permitted in any one bent, and not even two if the bent is more than 12 to 14 ft. high.

Decay in Piling

When piling has decayed so that it does not function properly, renewal or replacement should be undertaken immediately. If only one or two piles in a bent have failed, these may be replaced with timber posts by cutting the piles off below the point of failure and inserting the posts, but if more than two piles in a bent need replacement, other piles should be driven. In the latter case, it may be found more economical to drive new piles on both sides of the existing bent and to cross cap them underneath the main cap. Cases of settlement of pile bents because of insufficient penetration can be cured in many instances by excavating a trench along both sides of the bent and bolting heavy timbers to the piles so that they have bearing on the ground. If this should be considered inadequate, a concrete mat could be poured in the trench around the piles to give better bearing for the timber.

Where scour in a water course has undermined piles, they should be redriven with longer piles at once and an effort should be made to prevent further scour by placing heavy riprap around the bent. Frequently, study of stream conditions and a small expenditure of money to change the direction of the flow on the upstream side of the structure, or to clear away obstructions downstream to allow a quicker run-off, may improve conditions and reduce materially any danger of undermining. Furthermore, records should be checked to provide an accurate knowledge of the length of the piles in place to insure that adequate protection has been afforded.

Concrete Structures

Usually, if as-constructed plans of concrete piers and abutments are available, information as to the underlying soil conditions at the time of construction can be obtained, which will give some idea of what may be expected in case of floods. Where structures rest on soil subject to wash or scour, special attention should be given to them by making frequent and careful underwater inspections, by excavation, if necessary. It is an expensive operation to underpin structures of this kind, and in most cases the necessity for this can be avoided by driving sheet piling (either steel or wood) around the structure to a point well below the footing. If wood sheeting is used, it should be treated. In the case of abutments, this operation will be necessary only at the front and at both ends.

When undermining has taken place, it will be necessary to take immediate steps to save the structure, either by underpinning it or by driving sheet piling and grouting under the footing. In either case this is an expensive job, because the work has to be done in small sections, bringing the new work up to the undersurface of the old footing and making sure that it is carried well down below any danger of future trouble. In many cases, by the use of a diver, it may be found that the cavity can be filled by driving sheet piling around the structure and then pouring in concrete by the tremie method. The undermining of abutments generally takes place at the front or toe and can be remedied by underpinning in sections. In the case of both piles and abutments, as an extra safeguard against future troubles, the sheet piling should be left in place.

Ruptures appearing on concrete substructures are, in most cases, the result of faulty foundations. In some cases, however, they are the direct result of the improper functioning of the expansion rollers of the superstructure, which causes a severe strain on the masonry. If a faulty pier foundation, resulting in settlement and subsequent rupture, cannot be cured by underpinning, the reconstruction of the pier may be the only safeguard. However, as a first step, it is good practice to place heavy steel bands around the pier and fill cracks with cement so that further progress in settlement may be easily detected.

Faulty Bridge Seats

Faulty bridge seats are often a source of trouble and are usually due to wear under the bridge shoes. This defect, if not too far advanced, can be overcome easily by the use of quick-hardening compounds that are obtainable on the market for filling up the depressions without disturbing the regular operation of trains. If bridge seats are cracked, however, allowing moisture to get down into the structure, they should be renewed. This applies equally to stone piers and abutments. Sometimes the bridge seats of stone structures fail before other parts of these structures, due to the concentration of the shoe loads on small areas. Such failures can be repaired with little trouble by casting a block of reinforced concrete of the proper size and making the replacement under traffic.

Many old concrete piers and abutments, built before the advent of modern concreting methods, have a tendency to disintegrate by shelling off, sometimes to a considerable depth. To prevent the continuation of such disintegration, the best action to take is to remove all loose or scaling material and then to encase the entire structure with reinforced concrete, well anchored to the old concrete; with complete renewal of the top of the pier to a depth of two to three feet below the bridge seat. This same procedure can be followed in strengthening and refacing old masonry or stone piers when the stonework begins to crumble or spall badly.

Stone Masonry Structures

The disintegration of stone may be due to overloading or to uneven texture of the stone itself, but in any case it is serious enough to require attention. If only a few stones are affected, they can be removed and the holes faced up with concrete.

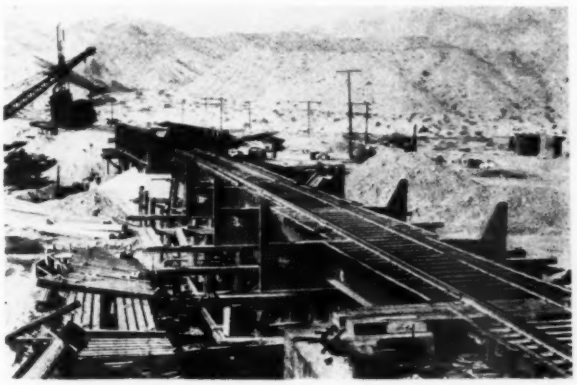
Many masonry substructures in existence today were built from 50 to 80 years ago, and the fact that they are still serviceable, in spite of the heavier power and increased speeds to which they are subject, speaks well for those responsible for their design and construction. In many cases both stone piers and abutments were supported on pile foundations covered with a heavy timber mat or grillage, no doubt to avoid deep excavation. The majority of installations of this type of construction have stood up exceptionally well, but in some cases, where scour has occurred, these structures have been entirely undermined and left standing with nothing but their pile support. In such cases, the usual procedure of repair has been to surround the pier or abutment with sheet piling driven well below the point where scour is liable to occur, and to fill the void beneath the structure with concrete or crushed stone, the latter being pumped full of grout to form a solid mass. In all cases the sheet piling is left in place as a further protection against subsequent scour. This practice is much less expensive than the complete renewal of the structure, and the work, in most cases, can be done without serious interference with regular traffic.

Disintegration of Mortar

Another cause of failure which should be guarded against is the disintegration and washing away of the mortar in horizontal joints. If this is not given the proper attention it allows the stonework to sag and the superstructure to settle. When this occurs to the point where the stone courses come in contact with each

other, there is little that can be done except to rebuild the structure. Where excessive pointing is required, it has been found that this can be done economically with a cement gun. This method is much better than hand pointing, but care must always be taken to have the joints well raked out before the new mortar is applied.

Piling and timber grillages are usually submerged in water, with the result that they seldom fail from decay. However, where they become exposed through some change in the water course or for any other reason, decay is liable to set in, making it necessary to underpin the structure. This is done by removing the grillage and piles in small sections so that the superstructure can be carried down to a solid foundation.



To Safeguard This Bridge Against Scour, Its Abutments and Pier are Supported On and Are Keyed to H-Section Steel Piles, Up to 90 Ft. Long.

Where there are indications of scour at or about a pier or abutment, the progress of the scouring can be stopped by placing heavy riprap around the structure, but in all cases of this nature a thorough inspection should be made to discover the causes. It may be due to some projection into the stream at a point on the upstream side of the bridge, the formation of a sand bar, the construction of a small dock, or may even be caused by sunken tree trunks or drift wood.

Core Grouting

Many of the older stone substructures that are still in existence were built with an ashlar casing of headers and stretchers, with a center core of rubble and mortar. Frequently, little attention was given to the matter of voids in the core, with the result that many of these structures have had to be strengthened or rebuilt to take care of the heavier loadings of recent years. In most cases it is possible to avoid the necessity for renewal by forcing cement grout into the core under pressure, thus solidifying the structure. A simple method of doing this is to drill holes, 1½ or 2 in. in diameter, vertically through the core from the bridge seat to the foundation, into which grout may be forced by a grout gun at sufficient pressure to fill all voids. Grouting has also been accomplished successfully through holes drilled at suitable intervals in the face of the structure.

In conclusion, your committee points out that the inspection of substructures is one of the most important duties of the bridge and building forces, to the end that defects which might develop into possible failures can be detected and steps taken to prevent their further progress. Any defect of whatever nature should be investigated so that the cause can be found and removed. If, for example, the track on a pile or frame trestle is out of line or surface, the cause may be decay in some of the timbers, loose or insufficient bracing, inadequate penetration of the piling, undermining or any one of the other factors mentioned previously. Settlement of track on the approaches may be a warning that the back of the timber endwall is giving away due to decay; in fact, any change in line or surface of track, on either the structure or its approaches, should be considered as a warning that immediate attention is required.

Sounding rods can be employed to detect any changes in a river bed at or near structures. If it is impossible to determine true conditions by this method, divers should be used.

Preventing Scour

The Chicago & North Western advises that it has had considerable success in preventing scour by the installation of fascines around piers, which settle into place when scouring starts, thus preventing serious damage. The Chesapeake & Ohio, in the construction of new piers and abutments, has used concrete piles from 60 to 90 ft. long, protruding 30 ft. above the river bed. These are driven in four rows, with nine piles to the row, tied together with three reinforced concrete diaphragms 18 in. thick, and topped with a reinforced concrete bridge seat 6 ft. thick. The Canadian National follows a similar design but uses 12-in. by 12-in. steel H-beam piles, tied together by welding in struts and angle braces. In some cases the piles employed have been driven to a depth of more than 100 ft., to solid rock, to preclude any possibility of scour.

Committee—E. C. Neville, (chairman), b. & b. mast., C. N., Toronto, Ont.; W. A. Sweet (vice-chairman), gen. foreman b. & b., A. T. & S. F., Newton, Kan.; L. B. Alexander, asst. bridge engr., M. C., Detroit, Mich.; B. F. Cary, b. & b. supv. Sou., Alexanderia, Va.; S. D. Fournier, bridge insp., P. M., Detroit, Mich.; H. M. Harlow, asst. supv. b. & b., Chesapeake & Ohio, Clifton Forge, Va.; C. S. Heritage, bridge engr., K. C. S., Kansas City, Mo.; C. T. Kaier, gen. bridge insp., D. L. & W., Hoboken, N.J.; F. H. Masters, ch. engr., E. J. & E., Joliet, Ill.; E. M. McCabe, b. & b. supv., B. & A., Pittsfield, Mass.; K. L. Miner. b. & b. supv., N. Y. C., Beacon, N.Y.; N. W. Morgan, bridge engr., U. S. Bureau of Public Roads, Washington, D.C.; E. T. Richie, mast. carp., D. & R. G. W., Pueblo, Colo.; A. B. Scowden, gen. bridge insp., B. & O., Cincinnati, Ohio; T. H. Strate, div. engr., C. M. St. P. & P., Milwaukee, Wis.; and H. A. Wistrich, bridge engr., L. V., Bethlehem, Pa.

Discussion

A long discussion followed the presentation of the report, with respect to the replacement of failed bridge seats, the general conclusion being that the best method is to cut out the old masonry to the back wall and use precast concrete blocks set in mortar to make the replacement. The remainder of the discussion revolved around means for protecting substructures where considerable scour has occurred, and a number of speakers cited cases where fascines have been used, the general conclusion being that this form of protection is superior to the dumping of loose stone around piers and in front of abutments.

During this part of the discussion a description was given of the fascines used in one case around a pier where scour was serious, in which stones of less than one man size were enclosed in willows, which were then wrapped with woven wire. A more permanent form of fascine was also described, made in cradles similar to those used in connection with river protection work, the statement being made that dogwood provides the best material for enclosing the stone which, in general, should be not larger than one man size. Several other members who had had experience with dogwood recommended its use for this purpose instead of willows.

Deteriorated Concrete— Causes, Detection and Methods of Repair

Report of Committee

S. T. Corey
Chairman

CONCRETE is primarily a simple mechanical mixture of sand, stone, cement and water, which "sets up" or hardens under hydrolysis and hydration into a hard, stone-like mass. Owing to the very nature of its ingredients, that is, the sand, stone and products of crystallization, which retain their individual characteristics, all concrete is more or less porous, and the degree of porosity will, in large measure, determine its durability and, consequently, its life.

Causes of Deterioration

It is not the province of this report to consider the effect of structural design on the character of the deterioration of the concrete of which a structure is composed. Deterioration proceeds whether or not proper consideration has been given to the purpose for which the structure was built. A structure of good design is less vulnerable to deterioration, but this great advantage may be vitiated if the concrete is of poor quality.

The primary causes of the deterioration of concrete structures of good design may be ascribed to faulty materials and poor workmanship. Many deteriorated structures were built 25 to 50 years ago when little technical information was available. In spite of age, however, many of these structures are as sound today as when constructed. On the other hand, many recent structures, built under modern specifications, show marked deterioration.

The only tenable explanation of this apparent contradictory behavior of concrete lies in the multiplicity of causes of the deterioration, and combinations of them. Materials, workmanship, temperature alternations, soil, wetness, dryness, exposure and many other causes, each of varying character or magnitude, make it difficult to eliminate all but two or three and say—"these are the causes."

We are concerned, of course, with existing structures, practically all of which have no written historical record except quantities and unit costs. If less attention were paid to costs and more to recording the kinds and sources of materials, methods employed in mixing and placing, where water was obtained, soil conditions, temperature alternations, kind of waterproofing and other important data, the cause or causes of deterioration could be determined with accuracy and, what is more important, a repetition of the failure could be avoided in other structures which may be built in the same locality.

We list the more frequent and obvious causes of the deterioration of concrete as follows:

(1) Settlement of foundations; (2) scour; (3) dirty aggregate and poor grading; (4) dirty mixing water, containing oil, alkali or organic matter; (5) excess water or too little water; (6) placing concrete in a manner causing segregation; (7) wrong proportioning of materials; (8) inadequate bond between pours; (9) inadequate protection of the concrete during the setting period; (10) insufficient attention to curing; (11) alkali adjacent to concrete footings; (12) chemical action of water; (13) freezing and thawing; (14) deteriorated or ineffective waterpoofing; (15) corrosion of reinforcing bars; (16) unanticipated stresses, and (17) occluded water and low temperature.

Probably the most disruptive agency in the deterioration of concrete is occluded water, wherever low temperatures prevail during the winter. Everyone knows that water freezes at 32 deg. F., but little thought is given to the fact that ice increases 9 per cent in volume over that of the water from which it is formed. If the expansion is restrained, the water will remain liquid, but as the temperature is lowered the pressure increases very nearly proportionately. It has been found that if expansion is thus restrained, the pressure rises to 2,000 lb. per sq. in. at 30 deg. F., to 12,000 lb. per sq. in. at 20 deg. F., and to 30,000 lb. per sq. in. at minus 8 deg. F. It is obvious, therefore, that in porous concrete to which water is accessible and where the conditions for more or less restraint exist in the surrounding concrete, the internal pressure rises as the temperature falls below 32 deg. F. When the surrounding concrete is no longer able to withstand the rapidly mounting pressure, the latter is released and the water, changing to ice with explosive force, disrupts large masses of the concrete.

Much good concretework has been ruined by poorly placed and poorly protected reinforcing bars. Bars will not corrode unless moisture and air are present. Corrosion is accelerated by chemicals such as those present in sea water, smoke, brine and the like. Reinforced concrete members of small dimensions are most seriously affected. Alternate wetting and drying hastens the rusting, which commences at some point where there is insufficient covering of the bars or poor concrete. As rusting proceeds, considerable pressure is generated due to the increased volume of the oxidized iron, which tends to break down the surrounding concrete if it is of poor quality or of small thickness.

In considering the deterioration of concrete and its repair, it is essential to distinguish between damage due to weathering on the exposed surface and that due to water coming through from the back or earth side. Percolating water may remove some of the soluble constituents. All concrete will absorb water, but concrete of fine texture will take up water by capillary action more readily than coarse concrete. This is because the coarser concrete will permit more water to move through it under head.

Good dense concrete is apparently affected little by wetting and drying and it may even become tighter by the formation and deposition of calcium carbonate from the solution of the soluble calcium hydroxide in the concrete. When the concrete is porous enough to permit the solution to run out of the concrete, damage results from further percolation.

Water moving through a wall must

be stopped back of a point where it will freeze. Someone has proposed the slogan, "Keep water out—if it gets in, provide an easy way out."

Detection of Deteriorated Concrete

In many cases the fact that the concrete has deteriorated is obvious even under cursory examination but the primary cause of failure is not always clear. In other cases the deterioration is not apparent and it requires some knowledge and experience to interpret the significance of the symptoms noted during an examination. These symptoms are raveling, cracking, deposits, the popping or cracking of aggregates, color, texture, and the hardness and ring of the concrete, bad condition of the surface, deterioration due to structural defects, drainage, joints, exposed reinforcing bars, surface spalls, wear due to ice and debris, deterioration by water of high chemical content, and others.

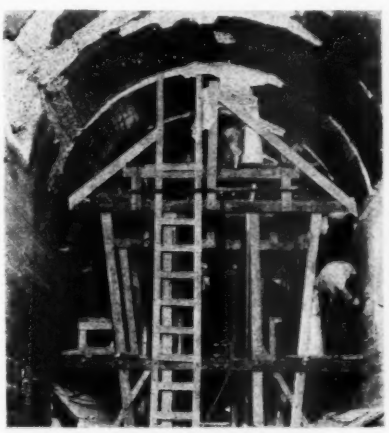
A proper diagnosis is imperative for successful treatment. Primarily it must be determined whether the concrete materials are at fault. Many of the symptoms indicated above are traceable to poor aggregate, but much good material has been rendered of little value by poor workmanship. A favorable time to make an examination is after rains while drains are still active but after some drying, or where rains are followed by freezing weather or during a thaw. If the actual conditions are not apparent from a superficial examination, it may be necessary to hack away a small piece of concrete with a sharp tool. Sounding with a hammer will often disclose internal defects. If the concrete rings well, sound concrete may reasonably be indicated; if a hollow sound is produced, loose concrete may be suspected; if a dull sound is heard, dead material is very likely present.

Repair of Deteriorated Concrete

General good practice has not been developed for repairing deteriorated concrete. This is shown by many crude attempts at repair. These failures are due largely to a lack of understanding of the proper methods and to inherent difficulties which may be met in certain cases. Many concrete walls and other structures show surface defects which, if neglected, may result in serious damage if not repaired. Such deterioration has been halted and, in many instances, entirely overcome by various surface treatments. Asphalt and cement paints have been found useful, but as a class have a rather limited field and a relatively short life and must be renewed at frequent intervals. Oil paints often saponify and surfaces coated with them must be repainted occasionally. Of the oil paints, a tung oil is recommended as a primer. Another sometimes used has a phenolic resin base for a primer coat, and straight linseed oil has been found, in certain cases, to be effective as a finishing coat.

Railings have been repaired by the application of a hot coat of 1-to-1 turpentine and raw linseed oil, followed by subsequent coats of hot oil until the concrete is saturated. A final coat of grey lead and oil paint was applied to give a satisfactory appearance. Other types of surface treatments consist of numerous mixtures of iron treated with sal ammoniac, or of emulsions of asphalt. Transparent waterproofings, consisting of various materials dissolved in volatile solvents are of little value.

Considerable difference of opinion exists as to the effectiveness of the so-called "iron treatment." Finely-



The Repair of Deteriorated Concrete in Tunnels Presents Many Difficult Problems

divided iron and sal ammoniac are applied to the wet surface of the concrete to be repaired, in the form of grout. The iron penetrates the pores and, expanding there upon oxidizing, presumably fills the pores completely. The application is usually repeated several times and is finally followed by a cement and sand wash. Sometimes this treatment has been used merely as a bonding medium before patching or when making an extensive application of new concrete to spalled surfaces. Numerous successful applications of this iron treatment are on record, but there have been many failures as well, the latter due possibly to the selection of the improper method of repair or to inexperienced workmanship.

Various forms of asphalt waterproofing have been used to repair deteriorated concrete surfaces. Asphalt dissolved in a petroleum solvent, commonly known as a "cutback," asphalt emulsions, or pure asphalt heated to the proper consistency, may be used when the conditions warrant. They are applied as paints or are trowelled on. The concrete surface to be waterproofed must be scrupulously cleaned and then primed with asphalt, well thinned, before application. When applied to exposed surfaces, asbestos fibre, sand or mica may be added to reduce volatilization of the essential oils by sunlight and to increase the strength of the film against abrasion.

The priming coat is followed by the application of two or more coats of the waterproofing material, making a film of substantial thickness. If the asphalt coatings are trowelled on, the thickness of each coat will be much greater than when brushed on, and require, therefore, less time to apply. The trowelled coat is a mixture of asphalt and cement or sand, and is of putty consistency. In either case the completed film should be from 1/16 to ⅛ in. thick. Pure asphalts are weak mechanically and should not be used to fill cracks or cavities. Emulsified asphalt may be used, however, if mixed with cement, using about 10 lb. per gal. of emulsion. Additional strength is obtained by adding clean sand to the asphalt and cement mixture. Asphalt coatings are effective if used between the surface to be waterproofed and the source of the moisture. If the surface is under pressure from behind, the effectiveness of this type of waterproofing is greatly reduced.

Cracks frequently appear in thin concrete or plastered walls, thus allowing moisture to penetrate from the outside. These cracks may be closed by grooving, calking and painting if of appreciable width and if not numerous. If they are small in size and large in number, any good cement paint or raw linseed oil can be used successfully. This treatment may have to be repeated several times.

The waterproofing of construction joints and structural cracks, particularly where water pressure is high, is exceedingly difficult. If the concrete is not subject to freezing temperatures and the joints are narrow, they may be calked. The procedure is as follows: First, a drainage system of some kind should be installed to collect and remove the water. The joint or crack should then be channeled and thoroughly cleaned. The channel should be square-cut, approximately ½ in. wide by 2 in. deep, and then widened to 1 in. for the first 1 in. of depth. After the sides and bottom of the channel have been thinly primed with cutback asphalt, the ½-in. by 1-in. space in the bottom should be calked with oakum and sealed by filling the front space with cement

mortar or asphalt and cement mortar. Cement mortar should not be used if there is structural movement.

If the joint or crack is exposed to freezing temperatures, it is imperative to block the water at its source. If water freezes back of the calking the calking will, in all likelihood, be forced out by the expanding ice. In any case, if it is at all possible, some means should be taken to prevent water from entering the crack or joint at the rear of the wall as moisture will spread into the adjacent concrete by capillary action and saturate it, thus inviting deterioration from subsequent freezing and thawing. Cracks or joints may be protected from moisture entering from the face by grooving and filling with cement mortar, or, if primed, as indicated above, by filling with asphalt-cement roofing mortar, plaster or emulsified asphalt.

It becomes necessary frequently to patch or plaster small areas which have weathered. If these areas are allowed to continue to weather they will result in an unsightly appearance and the safety of the structure, if small, may ultimately be endangered. In such repair, proper preparation of the surface is essential. Means must be taken to overcome the tendency of the new concrete to shrink in setting up and to secure a good bond to the old concrete. Loose and decayed materials must be carefully removed. The edges of the old concrete, outlining the patch, should be cut vertically (preferably under-cut a little) an inch or more, if necessary, and the surface should be cleaned thoroughly of all dust and fine particles by brushing and flushing with clean water. Before applying the new concrete, the area should be soaked with water, but all excess moisture should be removed just previous to the application.

Avoid Shrinkage

To avoid shrinkage of the new concrete, it has been found that mixing the mortar for a certain period before the patch or plaster is applied is effective in most instances. The proper period that the mortar should stand before it is used can be determined experimentally.

To secure adequate bond, successive coats of thick cement grout of one part cement to one part sand should be brushed on the prepared surface of the old concrete, allowing each coat to dry until it is tacky to the touch. After three, four or five coats, as may be found necessary, have been applied, the patch or plaster material should be trowelled on and thoroughly cured by covering it with a damp cloth, kept wet for several days. Each operation should be done with great care and without haste; otherwise the job is very likely to be unsuccessful.

Where large areas are involved, requiring a large volume of new cement-mortar or concrete, it is essential to apply the latter by the pneumatic process, or by the usual method of constructing forms and filling with concrete, mixed, placed and cured according to standard practice. Pneumatically applied mortar for the restoration of deteriorated surfaces; the filling of interior voids in slabs, piers and walls; the filling of honey-combed shale foundation material beneath piers; and the filling of voids behind tunnel linings, has been successful in some cases and unsuccessful in others. This method requires expert knowledge and the most skilled workmanship.

A successful restoration by means of cast concrete depends largely upon the condition of the old concrete beneath the deteriorated area to be restored. As in patching, all loose and decayed material must be removed until a fairly sound body of concrete has been reached, thus insuring good bond. Horizontal and vertical grooves may then be cut with a narrow chisel, three or four inches apart, and the surface thoroughly cleaned and wetted before deposition of the new concrete.

Shrinkage may be a troublesome factor with this method as well, but if the volume of the new concrete is not great, pre-shrinking may be resorted to. If the volume is large, the concrete should be as dry as it is practicable to place. As in patching, careful attention must be given to the curing, the period to be long enough to insure against rapid drying of the new concrete. Sometimes dry-pack mortar is used, either tamped or rammed, or slapped into place by hand.

Reinforcement should consist of mesh or bars, or both, and should be fastened securely to dowels or anchor bolts and located not less than 1 in. from the surface of any concrete that will be subjected to exposure.

In no case should fresh material be applied to a dry surface. The first, or bonding, coat should be composed of one part cement to one part of sand; should be of plastering consistency, plastic at the time of application; should be applied to a thickness of approximately ¼ in. immediately prior to placement of the body of the new concrete; should be applied to the surface with force and should not be disturbed until the next layer of new concrete is applied.

Successive layers of concrete should be applied in every case while the preceding one, including the bonding coat, is still plastic. If a layer is allowed to harden in place until it has acquired sufficient strength to hold the next layer, the next layer should be applied as a bonding coat.

All trowelling and floating of the plastic finished surface should be done lightly to limit its effect to the surface as far as possible. After the bonding coat has been applied to a horizontal top surface, the concrete should be rammed into place until the cavity is overfilled. The patch should then be further consolidated by hammering on a board in contact with, but extending beyond, the patch. This should be repeated prior to the initial set of the cement; final finishing to be done by light troweling.

If possible, when packing concrete in forms, it should be placed in layers, each rammed solidly into place while the preceding layer is plastic. Vibrators, if used, should preferably deliver not less than 3,000 impulses per minute.

The committee gratefully acknowledges the assistance given to it by the Portland Cement Association in furnishing a list of references from which a large part of the material for this paper was prepared. Among them are the following:

R. B. Young, Journal of the American Concrete Institute, March-April, 1937; F. W. Capp, Journal of the American Concrete Institute, May-June, 1936; American Railway Engineering Association—Manual 1933.

Committee—S. T. Corey (chairman), asst. bridge engr., C. R. I. & P., Chicago; C. U. Smith (vice-chairman), g.m. & ch. engr., Harbor Commission, Milwaukee, Wis.; Maxfield Baer, ch. conc. insp., C. & N. W., Chicago; E. H. Brown, bldg. supt., N. P., St. Paul, Minn.; F. G. Elmquist, bridge insp., C. M. St. P. & P., Chicago; J. S. Hancock, bridge engr., D. T. & I., Dearborn, Mich.; O. J. Hein, drftsmn., C. & N. W., Chicago; W. J. Lacy, b. & b. supv., M. P. Jefferson City, Mo.; C. A. Landstrom, mast. carp., C. B. & Q., Burlington, Ia.; W. J. Martindale, bridge foreman, T. H. & B., Hamilton, Ont.; L. R. Morgan, transitman, N. Y. C., Syracuse, N. Y.; W. V. Parker, const. enrg., Memphis, Tenn.; C. A. J. Richards, mast. carp., Penna., Chicago; and E. E. R. Tratman, civil engr., Wheaton, Illinois.

Discussion

A. E. Bechtlehimer (C. & N. W.) asked if the committee recommended the waterproofing of new concrete surfaces to prevent deterioration, or only the waterproofing of surfaces which already show deterioration. In reply, Chairman Corey said that some surfaces weather very slowly, but cited several instances where unfavorable water conditions had caused failures of concrete that could have been prevented by waterproofing. He added that he had rarely seen a perfect concrete surface and emphasized the need in most cases of waterproof-

ing before deterioration gets started. Continuing, Mr. Corey cited examples of deteriorated concrete, one being the piers of the Rock Island's old Cimarron River bridge, where the concrete had deteriorated and had been eroded by the water, which contained a large variety of chemicals, among which was a salt content of 0.67 per cent, successful repairs to these piers being made, he said, by the iron and sal ammoniac method. The other case was a concrete slab of a bridge which had softened prematurely as the result of the use of an aggregate containing aluminite.

A. L. McCloy (P.M.) stated that successful waterproofing of concrete can now be accomplished with several commercial preparations available for that purpose, and called attention in particular to a liquid product which, when mixed with cement, makes it quick hardening, and adapted to repairing concrete, even against hydrostatic pressure. He also mentioned the effectiveness of cleaning old concrete with muriatic acid before pouring the new concrete in patch work, explaining that the acid attacks the cement and provides a roughened surface.

G. S. Crites (B. & O.) suggested that cleaning with muriatic acid would not be successful with limestone aggregate as the acid would attack the limestone, but that it would undoubtedly be satisfactory where silicious aggregates were involved. G. E. Boyd *(Railway Engineering and Maintenance)* pointed out that where the acid method is used, the concrete must be well washed with water after the application of the acid. He also called attention to the deterioration of concrete by electrolysis and stated that deterioration from this cause, while not common, can be very severe where stray electrical currents are permitted to exist.

O. H. Gosswein (technical service manager of the Universal-Atlas Portland Cement Company) warned that where muriatic acid is used for cleaning concrete, a weak solution (4 per cent) should be used.

Following questions relative to the effect of sea water on concrete, Chairman Corey said that tests had indicated that sea water does not have as injurious an effect on concrete as water in streams in which the concentration of salt varies widely.

The Maintenance of Shop and Enginehouse Roofs

Report of Committee

G. S. Crites
Chairman

THE primary purpose of a shop or enginehouse roof is to keep out rain and snow and thereby keep the interior of the building dry. In addition, however, a roof should do its part towards preserving warmth in winter and providing comfort in summer. Any roof, insulated or otherwise, will radiate some heat in winter and will transmit heat to the space beneath it on warm sunny days. Where the retention of heat in a building is not a problem, proper ventilation of the under roof space will largely take care of the situation. Even if a roof is insulated, ventilation is still important, because otherwise the insulating material may become saturated with moisture and turn into a heat conductor. Ventilation must be provided in any event to carry off gases and moisture from the building. More shop and enginehouse roofs fail from interior or underside decay than from exterior causes. Regardless of how carefully a wood deck may be constructed, vapors penetrate the planking, condense on the underside of the roof covering, and start rot, not only of the deck members and their supports, but also to some extent, of the roof coating itself.

Modern, adequately supported roofs with poured concrete, precast concrete or gypsum decks, appear to cause no maintenance problems. Periodic mopping of the coverings of such decks with the proper roof coating will preserve the outer roof material. It is the older types of roofs that give the most trouble.

It is advantageous to make inspections of roofs at regular intervals, preferably at the end of the winter or rainy season, so that damage may be ascertained and repairs made prior to the next such season. Each inspection should be followed by a report indicating what is needed to restore the roofing, such as patching, recoating or re-roofing, in part or in full. The inspection should be made by persons familiar with roofing materials and capable of judging quickly the most economical operations necessary to best preserve the roofing, and, in turn, the structure.

When an inspection indicates that extensive repairs must be made to the roof coating, it is essential that careful examination be made of the supporting structure also, that is, the sheathing and purlins. In many cases, it will be found that the sheathing is in such condition that it will not last the life of another roof covering, and that extensive repairs or renewals must be made. Cases have been known where the roof sheathing has fallen away, leaving the built-up roof covering suspended in the air. In some instances, the end joints of matched sheathing are midway between supports. All such possibilities of early failure warrant careful inspection before making extensive repairs to or renewals of the roof coatings.

Where it is necessary to make extensive repairs to the roof sheathing, the condition of the purlins should be examined. In many enginehouses of the older type, the purlins transfer their loads to the main girders through joist hangers; such hangers may be of cast iron, wrought iron or ordinary strap iron. It is well to inspect such joints carefully, as failure of the purlins is more likely at these points than elsewhere.

If major repairs, or the entire renewal of the sheathing are found necessary, due consideration should be given to raising the purlins so they will have bearing on the top of the main girders, thus eliminating a source of trouble, and, at the same

time, providing a more satisfactory job. This, of course, necessitates the building up of the outside walls commensurate with the depth of the purlins. At the same time, careful examination should be made of the underside of the roof deck to see that no excessive stresses are being imposed on it by improperly located line shafting, cranes, hoists or other heavy equipment. This is important because the sag in any part of a roof, caused by an overload of such equipment, will frequently crack open what, under normal conditions, would be a good, tight roof.

Wood Structures

Early built shops and enginehouses usually had roof supports of untreated timber. Untreated wood sheathing formed the deck, and untreated wood shingles or slate were fastened directly to this. For such roofs the slope had to be steep, and the life of the roof depended usually upon the life of the untreated sheathing. Fortunately, cut iron nails were used extensively, and few roofs blew off or were damaged seriously as the result of corrosion of the fastenings holding the sheathing in place. Repairs to such roofs are best made with treated wood for both supports and sheathing. Wood suitably treated for the purpose adds no additional fire hazard and is well worth the extra cost.

No particular problems are involved in using treated wood to replace untreated wood in shops and enginehouses. Where possible, the wood members should be preframed before treatment and study should be made to secure metal fastenings that will not corrode to the point of failure before the treated wood fails. Cut nails of pure iron or non-corrosive steel alloys, or nails of copper, zinc, aluminum or non-corrosive alloys of these materials are essential and, in the long run, economical for roof fastenings. When roof fastenings fail, the entire roof, or a large part of it, may be damaged or destroyed by the wind.

In the case of old roofs covered with slate, it is often possible to preserve them by mopping with a good quality of bituminous roof coating. Where the slate are in very bad condition, the worst places should be treated with suitable roof putty before applying the roof coating. Coal-tar pitch has high resistance to disintegration under exposure, but it is more susceptible to temperature changes than asphalt, and should not be used, therefore, as a roof coating on roofs with a slope of more than 2 in. in 12 in. A slate roof with a heavy coating of bituminous material is quite resistant to the action of heavy hailstones. However, such repairs to slate roofs are of only a temporary or preservative nature.

When the deck sheathing beneath slate rots, or when the slate are in bad condition, it will be found more economical to renew the slate with prepared shingles or prepared roofing than to attempt to replace the slate themselves. If the slope of the roof is more than four inches per foot, prepared or built-up type roofing may be used. In the latter case, however, it is best not to use built-up roofing employing coal-tar pitch, when the slope is more than two inches per foot.

Wood shingle roofs may be patched with wood shingles when minor repairs are required, but when extensive repairs are necessary or when the sheathing is decayed, the roof should be treated the same as a slate roof that is beyond normal repairs. In both cases, when the slope is less than four inches per foot, tongue and groove or other tight sheathing should be used.

There are some outstanding examples in the West of old shop and enginehouse roofs constructed with California redwood sheathing and shingles. These roofs, which are somewhat fire-resisting and resistant to decay, were put together with cut iron nails. In the South also there are shops and enginehouses built of cypress which have stood for many years with only minor roof repairs. Such structures are unusual and interesting, but it is recognized that they can not be replaced in kind economically.

Stone and Brick Structures

Many of the oldest shops and enginehouses had stone or brick walls with timber roof framing, either as clear spans or with intermediate post supports. The older of these structures were built for the then existing small locomotives and were not wide. Their roofs were generally similar to the roofs of wood frame structures of the same period, and the problems of roof maintenance and repairs for both types of construction are essentially similar. If the entire roof, including the supporting members, is not to be renewed in making repairs to these types of roofs, and only a new roof covering is to be placed, consideration must be given to the weight of the new roof covering to avoid overloading the old roof supports. This is necessary particularly in the case of flat roofs, although it is more than likely that such roofs will not be encountered frequently in shops and enginehouses.

Smooth-top bituminous felt roofs weigh from 150 to 250 lbs. per 100 sq. ft., depending upon the number of plies used. Under ordinary conditions, three plies should give 10 years service without maintenance, other than mopping; four plies should give 15 years service; and five plies should be good for 20 years, with only an occasional heavy hot mopping.

Bituminous slag-top roofs weigh from 450 to 600 lbs. per 100 sq. ft., while bituminous gravel-top roofs weigh from 550 to 700 lbs. per 100 sq. ft. Various types of built-up or fabricated roofs may weigh in excess of 800 lbs. to the square. Such weights should always be taken into consideration when complete roof covering renewals are to be made.

In general, coal-tar pitch, because of its high resistance to the disintegrating action of water, makes an excellent roofing material. It is adaptable particularly for use in the construction of flat bituminous built-up roofs on which water may collect and stand. In addition, coal-tar pitch is self-healing, and even at ordinary temperatures will flow enough to close up cracks. However, on account of its ready flow, its use should be confined to roofs sloping less than two inches per foot.

Asphalt is less resistant to moisture than coal-tar pitch, but it is likewise less susceptible to temperature changes than tar, and, therefore, better suited for the construction of built-up roofing on steeper slopes. Unless asphalt is prepared specially for the purpose, it should not be used for built-up roofing on roof slopes of greater pitch than six inches per foot.

Few, if any, shop and enginehouse roofs now requiring heavy repairs or replacements are insulated. There are many reasons why roof insulation may be economical. When air comes in contact with the cold underside of a roof, its temperature is lowered. If the underside surface has a temperature below the dew point of the water vapor in the air, the excess moisture, with its corrosive content, is deposited on the surface as condensation. This moisture will penetrate the roof deck and will rot or corrode not only the deck and its supports, but also the roof covering to some extent. If the deck is of reinforced concrete or gypsum, the corrosive agents may be carried to the steel reinforcing members.

All roof decks move to some extent under temperature changes. When this movement continues over a long period of time, the roof cover-

ing may develop cracks. Good insulation not only minimizes movements due to temperature but also provides resiliency in the deck and prevents strains in the built-up roof materials, thus prolonging the life of the roof covering.

Insulation allows closer control of interior temperatures in both summer and winter, thus assuring more uniformly comfortable working conditions throughout the year. This, in turn, insures increased labor output. Insulation retards the loss of heat through the roof, effecting substantial economy in fuel.

At no stated intervals, but at such times as inspection shows to be necessary, roofs of the built-up types can be recoated with a liquid asphalt, without fiber content. This type of coating is for rejuvenating the felts and should have penetrating characteristics. It should be of the best quality and of brushing consistency, or it may be applied by spraying.

If a built-up roof with either a smooth or tar and gravel surface has been neglected to such an extent that the top coating felts show signs of weathering or damage, the roof may be restored by applying two new plies of saturated felt. In making such repairs, the old roof should first be cleaned thoroughly and any holes patched with three plies of felt, applied with hot moppings. To do this, first, mop the roof surface with hot tar, or asphalt, as the case may be, and then embed the layers of felt, mopping with hot asphalt between them and over the top. In the case of tar and gravel roofs, washed screened roofing gravel is embedded in the top coating. In no case should tar and pitch be applied over an asphalt roof, or asphalt over a tar and pitch roof.

One large road in the middle west has had considerable success in using a saturated cotton fabric instead of two plies of saturated felt. The surface is prepared as above and then mopped with hot asphalt, following which the saturated cotton fabric is laid in place and topped with another mopping of hot asphalt.

A relatively recent development in the maintenance of built-up type roofing is the use of cold liquid asphalt cements, instead of hot asphalt, for cementing the sheets together. The particular advantage of this material is that it can be applied by a road's own forces without the use of special equipment, such as kettles for heating asphalt, etc.

A good grade of roll or ready-roofing, weighing from 65 to 75 lbs., makes an economical and serviceable roof for buildings of a less permanent character, and of a type where it is not necessary to get an architectural effect.

The Type of Roof Covering Best Adapted Depends Upon the Character of the Roof, its Pitch, and Other Considerations

Corrugated galvanized steel is suitable for roofs on certain classes of buildings, and is economical in maintenance, particularly if painted. The first application of paint should not be made for at least one year after the material is installed, and not later than two years. Where corrugated galvanized steel roofs have become badly rusted, it has been found economical in some cases to coat them with two plies of Irish flax felt, or one ply of light ready-roofing felt mopped on with hot pitch and coated with the same material. The hot applications soften the felt, permitting it to sag into the channels of the corrugations.

Sheet metal roofs are not advisable where subjected to the corrosive action of smoke or other gases. On the other hand, there is evidence that the so-called corrugated iron materials marketed under several trade names have sufficiently greater life to warrant their use under certain conditions that may be encountered. Corrugated asbestos-protected metal, a patented material consisting of a corrugated steel sheet covered on its sides and edges with asbestos felt, and coated with a tough asbestos compound, is relatively expensive, but is economical for use on structures of the better class where there is no likelihood of the surface being abraided. Where abrasion occurs and the protective covering is damaged, moisture quickly destroys the steel sheet.

Corrugated asbestos-cement roofing is an excellent material, and while it is quite expensive, it is economical in use, giving a long life without maintenance cost other than may be occasioned by accidental injury. It is quite resistive to the action of smoke and other corrosive agents. Asbestos-cement shingles are also excellent for roofs, and while relatively expensive in first cost, are, like corrugated asbestos-cement roofing, economical of maintenance. They are particularly effective for use where appearance is a consideration, as they can be secured in many designs and colors.

Flashings

In all locations where rust or corrosion might be excessive, flashings should be of superior materials, such as copper, lead, or lead-clad steel. Weak flashings are often the cause of the partial destruction of otherwise excellent roofs, and the relative cost of repairing such damage and of installing new flashings is high. Where metal roofs and flashings are of different metals, such as galvanized steel sheets and copper flashings, care should be taken that the flashing is well coated with asphalt or similar material, to preclude electrolitic action which might destroy one or both of the metals. Metal counter-flashing, which is let into the wall for a depth of at least 1½ in., with a turn-up at the back edge secured by flashing hooks or metal wedges, and sealed with calking cement in the joint, probably has a better service record than any type of composition flashing.

The proper joining of composition roofing with roof drains and drain boxes is of great importance. The joints at these points are a primary cause of leakage due to the movement of either or both the roof deck and the drainage lines fracturing the roofing felts. The best practice is to require that the leader heads or metal outlet boxes be equipped with a generously wide flange, and that the flange be installed over the completed roof covering, and not under it or between the plies. The flange should be well buttered with plastic cement on its underside, and if the roof deck is of wood, it should be nailed securely in place and then covered with two sheets of roofing felt, double the width of the flange, mopped in place with roof cement.

The fastenings for roofings should be carefully selected to secure the proper type for each type of roofing. The generally accepted types of roofing fastenings are nails, bolts, screws, wire clips, cleats and seams, with a bitumen binder for applying the felts on flat roofs.

Fastenings should be selected with the view that they will outlast the roofing they secure in position. Dissimilar metals, when in contact in the presence of an electrolyte, set up galvanic action, resulting in the deterioration of one of them. The following table lists the more common commercial metals according to the electro-chemical series:

1. Aluminum 2. Zinc 3. Steel 4. Iron
5. Nickel 6. Tin 7. Lead 8. Copper

The galvanic action increases as the metals are farther apart in the above series. Where two dissimilar metals come together, they should be insulated from each other by (1) asbestos, (2) sheet lead, (3) heavy tinning of the ferrous metal, (4) heavy saturated felt, or (5) a heavy coat of asphalt paint.

For securing built-up roofing laid over a roof deck of wood, gypsum, nailing concrete, certain types of insulation, and nailing strips in concrete, large-head galvanized nails of the required size should be used, driven through flat tin discs. For sheet metal roofing, the fastenings used are generally nails and cleats of the same metal as the roofing. In fastening the sheets, do not nail them tightly to the roof deck, as ample provision must be made for their free expansion and contraction.

For slate, asbestos or tile shingles, the fastenings should be of copper, copper alloys or non-corrosive steel alloys, of the sizes and types required for each type of shingle. For wood shingles, the nails should be of hot-dipped, zinc-coated iron, cut; of hot-dipped, zinc-coated steel and copper; of copper; or of non-corrosive steel alloys, of the sizes required.

For asphalt shingles, the nails should be large-head galvanized zinc-clad, copper, or non-corrosive steel roofing nails. For metal shingles or tiles, the fastenings should be of the same metal as the roofing to prevent electrolysis, except in the case of lead roofing, where copper fastenings should be used. For composition roofing, the fastenings should consist of zinc pyramid caps or roof cleats, galvanized nails and lap cement. The cleats help seal the laps and also minimize the possibility of this type of roofing being torn off by heavy winds.

For corrugated metal roofing, the fastenings should be of the same metal as the roofing. Where the roofing and roof deck or its supporting members are of dissimilar metals, the fastenings must be insulated to prevent electrolysis. For corrugated asbestos roofing, the fastenings should consist of aluminum tie wires with lead washers, and hot-galvanized bolts, washers and clips of non-corrosive metal for steel construction; and of hot-galvanized wire nails or screws of non-corrosive metal for fastening to wood.

The greatest economy in roofing repairs is effected by promptness—that is, by making the necessary repairs as soon as defects are discovered, and not allowing them to spread. Many a good roof has been destroyed by the wind getting beneath it at one small opening. Much damage can be done to the contents of buildings by small leaks that can be stopped readily at nominal cost. Of greatest importance is the fact that a small leak can cause as much damage to the structural members of a roof as a large one.

Committee—G. S. Crites (chairman), div. engr., B. & O., Punxsutawney, Pa.; L. C. Winkelhaus (vice-chairman), arch., C. & N. W., Chicago; P. Aagaard, gen. bldg. insp., I. C., Chicago; M. A. Beringer, b. & b. foreman, Y. & M. V., Baton Rouge, La.; H. F. Bird, b. & b. insp., N. Y. C., Jersey Shore, Pa.; W. R. Ganser, mast. carp., L. I., Jamaica, N. Y.; E. A. Gephart, b. & b. supv., Alton, Bloomington, Ill.; F. A. Haley, b. & b. insp., N. Y. C., Brewster, N. Y.; W. F. Meyers, b. & b. supv., C. & N. W., Boone, Ia.; E. L. Rankin, acting architect, G. C. & S. F., Galveston, Tex.; F. A. Seites, b. & b. supv., C. & O., Huntington, W. Va.; E. W. Singer, b. & b. supv., N. Y. C. & St. L., Ft. Wayne, Ind.; O. W. Stephens, track supv., D. & H., Oneonta, N. Y.; C. R. Taggart, b. & b. foreman, C. C. C. & St. L., Indianapolis, Ind.; R. E. Wait, b. & b. supv., Wabash, Decatur, Ill.; W. Walkden, bridge engineer, Canadian National, Winnipeg, Man.; C. F. Weir, bridge and building supervisor, Pere Marquette, St. Thomas, Ont.

Discussion

In discussing the importance of inspection, cases were cited where roof failures had occurred by reason of advanced decay which had not been discovered by cursory inspection because the timbers appeared to be in good condition. Some question was raised concerning the application of roofing around drainage openings, as suggested by the committee, but Chairman Crites explained that the committee's recommendation referred to general practices and not to cases where there were wide differences between high and low temperatures, such as were mentioned in the criticism of the report.

Another criticism was of the item recommending the use of treated sheathing in making repairs to roofs. The chairman explained that this recommendation was made with a view to avoiding frequent piecemeal repairs and that the additional cost of treated wood for this purpose is usually quite small compared with the total cost of making the application.

Attention was called to the fact that many enginehouse roofs are built with the purlins laid laterally with the axis of the stalls, where they act as retarders to the circulation of the gases, whereas if they are placed longitudinally with the axis of the stalls they will act as flues to carry the gases to the high point of the roof, where disposition can be made of them.

Bridge and Building Supply Men's Exhibit

THIRTY-ONE manufacturers of equipment and materials used in the construction and maintenance of railway bridges, buildings and water service facilities, under the auspices of the Bridge and Building Supply Men's Association, presented an exhibit of their products in connection with the convention of the American Railway Bridge and Building Association at the Hotel Stevens, Chicago. The officers of the Supply Association who arranged for and were responsible for the exhibit, which was held in the exhibition hall immediately adjacent to the convention room were: President, K. T. Batchelder, president, Standard Heater & Insulation Company, Chicago, and manager railroad sales, Insulite Company, Chicago; treasurer, Harry A. Wolfe, assistant manager railroad sales, The Lehon Company, Chicago; secretary, W. S. Carlisle, representative, National Lead Company, Chicago; honorary director, L. F. Flanagan, representative, Detroit Graphite Company, Chicago; and the following members of the executive committee—E. E. Thulin, representative, Duff-Norton Manufacturing Company, Chicago; C. C. Rausch, representative, Dearborn Chemical Company, Chicago; Geo. E. Morrow, sales manager, Reade Manufacturing Company, Inc., Chicago; G. W. Anderson,

representative, Patterson-Sargent Company, Chicago; C. E. Ward, representative, U. S. Wind Engine & Pump Company, Batavia, Ill.; and A. J. Filkins, president, Paul Dickinson, Inc., Chicago.

In the election of officers for the ensuing year, Mr. Wolfe was elected

K. T. Batchelder
President

president; Mr. Rausch was elected vice-president; H. M. Winandy, assistant manager railway sales, Celotex Company, Chicago, was elected treasurer; and Mr. Carlisle was re-elected secretary. The new directors elected were: F. A. McGonigle, manager railway sales department, Mall Tool Company, Chicago; P. R. Austin, representative, Johns-Manville Sales Corporation, Chicago; and Ross Clarke, sales representative, Massey Concrete Products Corporation, Chicago.

A list of the exhibiting companies, together with the products on display and the names of their representatives present, follows:

List of Exhibitors

Air Reduction Sales Co., New York; acetylene welding outfit—C. B. Armstrong, J. Callahan, C. Daly, F. Huggins, J. Kenefic and J. G. Magrath.

American Lumber & Treating Co., Chicago; samples of Wolmanized timber and illustrations of its use—Robert R. Clegg and R. B. Putman.

Armco Railroad Sales Co., Middletown, Ohio; samples of Armco pipe and illustrations of applications—R. Y. Barham, E. T. Cross and E. Harbeck.

Barker Mail Crane Co., Clinton, Iowa; mail crane—L. P. Barker and S. N. Robb.

Buda Co., Harvey, Ill.; motor car; bridge and track jacks; tool grinders; gasoline power plant—R. M. Blackburn, R. B. Fisher and F. L. Gormley.

Celotex Corp., Chicago; insulation, wallboard; cold storage insulation; interior finish—J. H. Bracken, W. S. Millener and H. A. Winandy.

Construction Machinery Co., Waterloo, Iowa; concrete mixers; water pumps; electric saw; electric drill—A. V. Gibbs, A. H. Nelson, G. A. Loveall and L. W. Swett.

Dearborn Chemical Co., Chicago; No-Ox-Id rust preventives; sealing compound for wood water tanks; aluminum protective coating; pipe coating; wrappers for protection of underground pipe—J. A. Crenner, C. I. Loudenback, A. C. Moeller and C. C. Rausch.

Detroit Graphite Co., Detroit, Mich.; L. F. Flanagan.

Paul Dickinson, Inc., Chicago; roof ventilators; smoke jacks; stove jacks; roof drains; exhaust heads—A. J. Filkins, E. M. Filkins and William Harrison.

Duff-Norton Manufacturing Co., Pittsburgh, Pa.; bridge jacks—C. N. Thulin and E. E. Thulin.

Electric Tamper & Equipment Co., Ludington, Mich.; electric power units; concrete vibrators; electric tampers—Stanley Benson, H. W. Cutshall and Raymond Johnson.

Fairmont Railway Motors, Inc., Fairmont, Minn.; literature on motor cars—C. P. Benning, Kenneth Cavins and W. H. Ripken.

Fulton Asphalt Co., Chicago; compressed asphalt blocks—I. McDonald and J. C. Schmidt, Jr.

Ingersoll-Rand Co., New York; literature on compressors; pneumatic tools; jack-hammers; rock drills, hoists; sump pumps; pumps—K. I. Thompson.

Insulite Co., Minneapolis, Minn.; building insulation; cold storage insulation; combination insulation and building sheathing; insulating plaster base lath; roof insulation; tile and plank; and hard board products—K. T. Batchelder.

Johns-Manville Sales Corp., New York; samples of Transite pipe; corrugated Transite roofing and siding; asbestos roofing and siding shingles; Transite conduit; asphalt tile flooring; asphalt shingles; built-up roofing; prepared roofing; pipe insulation; asbestos wainscoting and wallboard; mechanical packing; asphalt plank—P. R. Austin, T. O'Leary, Jr., H. R. Poulson, W. W. Prosser, F. C. Vandervort and L. T. Youhn.

Lehon Co., Chicago; asphalt shingles; asbestos shingles; prepared and built-up roofing; aluminum paint; waterproofing materials—John Eipper, Tom Lehon, T. L. Kennedy, E. A. Leonard, R. J. Mulroney, John W. Shoop and Harry Wolfe.

Mall Tool Co., Chicago; gas-driven and electric-driven machines for vibrating concrete and surfacing concrete, with attachments for grinding, pumping water, drilling, boring, driving lag screws, wire scratch brushing and sanding—Robert Burgwald, A. W. Mall, F. A. McGonigle, M. Rehnquist and James Stewart.

Massey Concrete Products Corp., Chicago; literature on concrete pipe; concrete cribbing and crossing slabs—Ross Clarke, David A. Hultgren and W. L. McDaniel.

Master Builders Co., Cleveland, Ohio; samples of floor wearing surfaces; rust joint iron; non-shrink aggregate for concrete bonds; reground portland cement paint for concrete surfaces; liquid quick-

W. S. Carlisle
Secretary

setting compound; puzzolanic water-reducing agent for mass concrete—William Hinds, Donald Lee and B. R. Wood.

Modern Building Material Co., Chicago; E. A. Batchelder and K. T. Batchelder.

National Lead Co., New York; red lead; white lead; expansion bolts; linseed oil—T. Ancliffe, J. O. W. Belt, W. S. Carlisle, O. Meyer and Hugh M. Millen.

Oxweld Railroad Service Co., Chicago; soldering and brazing outfit; complete welding and cutting outfit—Lem Adams, Duncan Arnold, F. Finsthwait, C. J. Gavin, E. B. Hall, Jr., S. B. Hopkins, G. B. Moynahan and D. H. Pittman.

Patterson-Sargent Co., Cleveland, Ohio; bridge paints; and literature on bridge paints—Geo. W. Anderson, Ben Bowman and W. H. McBride.

Pocket List of Railroad Officials, New York; copies of Pocket List—B. J. Wilson.

Railway Engineering and Maintenance, Chicago; copies of publication—G. E. Boyd, L. R. Gurley, S. W. Hickey, N. D. Howard, E. T. Howson, J. G. Little, H. E. McCandless, H. H. Melville, H. A. Morrison, R. E. Thayer and J. S. Vreeland.

Ruberoid Co., Chicago; Geo. R. McVay.

T. W. Snow Construction Co., Chicago; Barton S. Snow and T. S. Daniels.

Timber Engineering Co., Washington, D. C.; timber connectors; full-sized timber-connector joints; and literature on connectors and timber design—L. P. Keith.

U. S. Wind Engine & Pump Co., Batavia, Ill.; pump jacks; float valves—J. P. Prindle and C. E. Ward.

Released Welded Rail

When rails that have been reconditioned by welding are released, for what further service are they adapted? Do they require special treatment before or after they are relaid? Why?

Two Points to Consider

By C. B. Bronson
Inspecting Engineer, New York Central, New York

There are two points to consider before these questions can be answered (1) Whether the rail section is heavy enough for either main-line or branch service; and (2) whether its general condition is such that it is reusable. If the rail is curve worn, or the top wear is excessive, it may be used either on sidings or classified as scrap. Assuming, however, that it is generally serviceable, all individual rails that should be scrapped for various reasons, and those that are fit only for side-track use, should be segregated. Obviously, neither of these classes require further treatment.

I see no advantage in treating the rail that is suitable for main-track use until it is placed in the track, the only exception being where the rewelding of the ends or excessive fishing wear warrants the cropping of the ends. This is more likely to be necessary because of fishing wear than because of the condition of the running surface. If cropping is resorted to, no further treatment will be required, assuming that the rails match satisfactorily with respect to loss of metal from the head.

Some attempts have been made to relay welded or repaired rails in direct sequence as they are removed from the track, for the purpose of matching adjoining rail ends. This is seldom successful, for certain rails are always weeded out, and so much care is necessary in loading and unloading that the cost may not be justified for the class of service they are to perform.

The correct procedure is to load the usable rails together, without any attempt to maintain the original sequence. After they have been laid and surfaced, any special treatment that may be necessary, such as building up or grinding, can then be given, considering each joint individually in deciding on the proper treatment.

I believe that in most cases little building up by welding will be necessary, except perhaps for an occasional joint, but that surface grinding will usually suffice, which can be done at small cost with effective results. It is assumed, however, that suitable joint bars, either new, reformed or shimmed, to insure a tight fishing fit, have been provided before attempting to apply either form of treatment.

Do Not Wear Uniformly

By C. W. Baldridge
Assistant Engineer, Atchison, Topeka & Santa Fe, Chicago

It is well known that rails do not wear uniformly. When rails are released, some will be very good, others will be fair, and the remainder will range on down to scrap. Thus some of them will be suitable for repairing track of the same importance as that from which they were removed; some will be suitable for relaying in secondary and branch-line main tracks; others will be fit only for side tracks; and below this will be the scrap. It is evident, therefore, that rails released from main tracks should be separated into three or four classes.

An inspection should be made of the rails before they are removed from the track and all rails that are suitable for repair purposes in track of the

Send your answers to any of the questions to the What's the Answer editor. He will welcome also any questions you wish to have discussed.

To Be Answered in January

1. *What precautions should be observed when trucking rails on push cars or trailers, to avoid injury to the men?*

2. *What is the most satisfactory method of flashing built-up roofing? Does the pitch of the roof make any difference?*

3. *What are the principal causes of foul ballast? What can be done in the way of prevention?*

4. *Should a permanent pile-driving record be kept for individual structures? Should this be detailed for each pile or for typical piles only? Why? Of what use is such a record?*

5. *What measures are desirable to insure that foreman take proper care of their motor cars? Who should be responsible for seeing that this is done?*

6. *Should repairs to wooden tanks be made by water-service gangs or by carpenter gangs? Why?*

7. *What measures should be taken to insure the accuracy of track gages and levels? Who should be responsible for insuring this accuracy?*

8. *What methods can be employed to obtain an attractive appearance when painting the exterior of an old brick building?*

same class as that from which they came, should be classed as No. 1 relayer; those suitable for secondary and important branch-line main tracks should be classed as No. 2 relayer. If four classes are provided for, rails that do not fall in Class 1 or 2 will be divided between those suitable for less important branches, rated as No. 3 relayers, and side-track rails, rated as No. 4. Occasionally a rail or a piece of rail will be found that is not suitable for reuse in any track and this will of necessity be thrown into scrap, and should be given a special marking.

An excellent method of marking rails to indicate their classification is to paint one vertical stripe on the web near one end for Class 1; two stripes for Class 2; adding an additional stripe for each succeeding class. Some rails look like No. 1 relayers when in the track, but when released will show kinks, flaws or damaged spots that were not evident before they were removed. Such rails can easily be degraded by painting one or more additional stripes. It is better to classify the rails while in the track, making the few corrections that will be necessary as they come out, because they rust quickly after removal, and any delay in making the classification may result in defects in the running surface being concealed by rust, thus causing the classification to be higher than it should, with no means of detecting the error until the rail is again in service.

Rails placed in classifications 1 and 2, which have been built up by welding, may be found after they are relaid, to need further building up by welding or in need of grinding to match the rails against which they are laid. The importance of the tracks in which the lower classes are laid seldom calls for either of these forms of treatment for the running surface. Many of these rails will have the fishing surfaces so worn that the old joint bars will not provide good joints, and sometimes new bars rolled to the original section will not be satisfactory. In such cases, a careful check should be made of the amount of wear and, if substantial enough, oversized, crowned or reformed bars should be used. For the remaining classifications, joint shims are likely to be satisfactory in taking up the wear.

When relaying released rails in important tracks, the height of adjacent rails should be checked after a few trains have passed over them. All joints showing a material difference in height should have this difference corrected, either by building up the low rail by welding or by grinding down the high one. On unimportant tracks the difference in height may, in some cases, be corrected by using a half shim, that is, under one rail end only. All of these methods are designed to provide better track and to lengthen the service life of the rail.

Same as Other Rail

By J. L. Monk
Section Foreman, Southern Pacific, Ft. Huachuca, Ariz.

When rails that have been reconditioned by welding are released, they should be classified and used the same as any other released rail, that is, for important or subordinate main tracks, important passing sidings, yard tracks, industrial tracks, etc., depending on the condition of the individual rails, always making it a point to replace lighter rail, preferably the older obsolete sections for which it is difficult to obtain joint bars. No special treatment is necessary before they are relaid, except to straighten kinked rails which should then be placed in sidings, never in main tracks. If the rails are to be relaid in main tracks they should be fitted with oversize bars to compensate for wear on the fishing surface, and should be built up or ground down, as needed, to insure smooth riding at the rail ends.

Pipe Lines in Cold Weather

What precautions can be taken to prevent pipe lines from freezing during severe cold weather?

Keep Below Frost Line

By J. H. Davidson
Water Engineer, Missouri-Kansas-Texas, Parsons, Kan.

The simplest precaution to prevent underground pipe lines from freezing is to place them deep enough so that there can be no danger of freezing. As an added precaution, to take care of unusually cold weather, especially where pipe lines are in actual use only at infrequent intervals, adequate drainage may be provided. Lines exposed in buildings and under water tanks can be protected against freezing by proper insulation, heating or drainage. These methods may be used separately or in any desired combination that will provide the protection most effectively and economically for any particular situation. Some of the factors that must be considered are the availability of a reliable source of heat, the cost of effective insulation and whether the pipe lines are in use constantly or for only a few hours a day.

Thorough drainage of pipe lines and other water-service facilities is the safest and surest method of preventing freezing, and it is, therefore, a good plan to have all such facilities that are subjected to severely low temperatures, so constructed and arranged that they can be drained when necessary. If service is required for only a few hours during the day this may be the most economical as well as the safest method.

Keeping the water in the lines in motion is another effective method of preventing freezing, and manually-operated pumping stations can easily be operated to take advantage of this fact. Automatically-operated pumping stations may often be so regulated that the pumps will be run frequently enough to keep the lines from freezing and at the same time keep the desired amount of water in the service tank. In some cases it is justifiable to waste some water to keep it moving in the pipe lines and thus prevent interruption of the service by reason of freezing.

Cannot Be Overemphasized

By K. J. Weir
Special Water Inspector, Chicago, Milwaukee, St. Paul & Pacific, Chicago

The desirability of precautions to protect pipe lines in severely cold weather can seldom be overemphasized. Obviously, the time to provide such protection is (1) when designing the distribution system and (2) when constructing it. The freezing problem is minimized, except for emergencies, if careful attention is given to the subject at these times. It is the pipe line that has been installed improperly that causes trouble and makes demands on the service man's time when working conditions are at their worst.

Underground pipe lines should be installed below the frost line, determined from experience over a period of years, and trenches should be backfilled, puddled and tamped before the advent of freezing weather. Backfilling with frozen materials permits infiltration of frost and subsequent freezing: When necesary to install an underground pipe line dur-

ing freezing weather, the pipe should be covered with a heavy layer of straw and the backfilling material should be heated, if this is possible.

The protection provided for storage-tank riser pipes is by means of the frost box. The correct design and construction of this form of protection are of vital importance, with particular stress on the insulating value of the materials employed, and the necessity for good maintenance. A recent frost-box design uses segmental sewer tile with slab-cork lining. A small by-pass pipe around the check valve in a pump discharge line, arranged for use as a bleeder during extremely low temperatures, will allow sufficient circulation back from the tank to prevent frozen riser pipes in many cases.

Water and sewer pipes inside buildings should be kept away from outside walls. If this is not possible, commercial pipe covering should be applied to give the desired protection. Automatic sprinkler systems require special attention, particularly for emergencies that occur during severe weather. Surface lines should be drained and arrangements made so that they cannot be used until warmer weather prevails. Water-column pits demand adequate drainage to insure against accumulations of ice that will make the columns inoperative. Vacant buildings should have all pipe systems drained and disconnected so that there will be no chance that they will be filled. Steam and hot-water systems should be checked before winter use to insure that no conditions are allowed to remain that might cause them to be frozen.

A thorough inspection should be made of all pipe lines late in the summer for the express purpose of determining points where freezing might occur. This should develop any special maintenance measures that will be necessary before cold weather and will be early enough to insure that needed materials will be obtained in time to make rush work unnecessary, at a time when other demands on the water-service forces are insistent.

Water Barrels on Bridges

What attention should be given to water barrels on bridges to insure that they are affording the desired protection at all times? What special precautions are necessary in cold weather?

Use Metal Barrels

By S. F. Grear
Assistant Engineer of Bridges, Illinois Central, Chicago

It is difficult to maintain water barrels on bridges; even keeping them on the bridges presents some difficulty. Formerly all of our barrels for this purpose were wood, but they have now been replaced largely by metal barrels. The wooden barrels failed because the hoops rusted and the barrels fell apart; or they collapsed because they were not kept filled with water and were allowed to dry out. Many of them were destroyed by trespassers who wantonly pushed them from their supports. During the prohibition era many were stolen, presumably for use in moonshine operations.

Metal barrels are lost in three principal ways: (1) by being pushed from their supports; (2) by rusting; and (3) by being punctured by bullets. These barrels seem to be favorite targets for men and boys who are carrying firearms. This is no different, however, from the trouble we had with the wooden barrels. Metal barrels should be painted inside and out with asphalt to retard rust. The supports must be substantial and the barrel should be anchored securely to its platform. We do this by using two 5/8-in. stay bolts, which are bent to hook over the top edge of the barrel. The barrels and their supports are subjected to severe vibration and frequent inspections are necessary to insure that the fastenings are kept tight. If railings are placed around the barrels, they should be kept in good repair; they aid in preventing trespassers from pushing the barrels from their supports. As a result of the losses that have been mentioned, there is a constant need for replacements, but we have not found any way to prevent these losses, for there is little chance to provide police protection.

Section foremen should see that all water barrels on their sections are kept filled at all times. To be effective from the fire prevention standpoint, each barrel should be provided with a bucket, and we have found that maintenance of the buckets is also a problem. We have found that buckets, cubical in shape, with 9-in. inside dimension, made from 7/8-in. lumber and with a 1/2-in. hole in the bottom, give the most satisfactory results. They are of no use, except for fire; they have no value; and therefore offer no incentive for theft. Covers should be made heavy, so that there will be less temptation for trespassers to remove them; the heavy cover also reduces evaporation.

In cold weather it is necessary to put some anti-freeze substance in the water. We use salt for this purpose and our instructions call for 20 to 60 lb. of salt to a 50-gal. barrel. This solution will not prevent freezing at very low temperatures, however. Again, the mixture of salt and water must be stirred frequently to keep the salt in solution.

Need Regular Inspection

By S. P. Shafer
Draftsman, Chicago, North Shore & Milwaukee, Highwood, Ill.

Water barrels on bridges should be kept filled by the section forces. They should be inspected regularly by the foreman or track walker, to insure that they are always full. At the time of the annual bridge inspection, the barrels and pails should be inspected carefully for decay and leaks, and should be replaced promptly if found to be defective. Prior to the approach of cold weather, sufficient salt should be added to prevent freezing. Since the brine will rust the metal hoops and buckets, it is essential that their condition be known at all times and that they be replaced promptly when they are found to be approaching failure; otherwise such protection as they are expected to afford will not be available in the event of a fire.

Questions Value

By F. W. Curtis
Supervisor of Safety and Fire Prevention, Denver & Rio Grande Western, Denver, Colo.

Where water barrels are maintained on bridges they should be inspected weekly to insure that they are kept filled; they should be kept covered and provided with a fire pail; and salt or calcium chloride should be used, in accordance with tables provided for this purpose, to depress the freezing point in winter. Salt will not prevent water freezing below zero, while calcium chloride is effective down to 40 or 50 deg. below zero.

Our experience with water barrels on bridges has taught us that they are difficult to maintain, for wooden barrels open between the staves at the water level, while the hoops on these

barrels and metal barrels both rust rapidly, and still faster if salt is used. If the barrels are painted, a dark or dull color is best, as this makes them less conspicuous as rifle targets. They are also expensive to maintain. The common method of filling has been by the local freight or branch-line crew, now almost a recollection only. It costs a lot of money to keep bridge-barrels filled with water, especially where evaporation is rapid.

The value of the water barrel is vanishing. With the installation of fire decks, clean surroundings, tight ash pans and reduced stack sparks, the need for and the value of water barrels at bridges are almost nil. At best, a water barrel is only primary protection and with fewer maintenance men and gangs working over a more extended territory, the likelihood of early discovery of a bridge fire is small. However, some needs are seasonal. In some high altitudes there is a blanket of snow during most of the winter, and at this time water barrels are unnecessary. On the other hand, these same sections may have great need for fire protection during the dry season, and water barrels may suffice.

Our records do not justify the general use of water barrels. Bridge fires that were or could have been quenched by having water barrels handy do not justify the expense of a general program of such protection. Against this, the importance or value of certain bridges makes it seem desirable to maintain water-barrel fire protection in the hope that some one will be near in case a fire starts. That, however, is about the limit of their value. Maintenance officers should refigure the cost of and benefits derived from water barrels on bridges and decide on their retention or elimination. They should not continue them merely as a matter of custom.

Keep Filled

By L. G. Byrd
Supervisor of Bridges and Buildings, Missouri Pacific, Poplar Bluff, Mo.

Water barrels placed on bridges for fire prevention should receive the same careful attention as all other fire-fighting equipment. The barrel itself must be maintained in good condition, securely fastened, in a place that can be reached easily and quickly in case of a fire, and to be of any value must be kept filled with water at all times. A cone-shaped bucket should be provided for each outside barrel, to be placed on the cover and secured by means of staples over the bail, firmly enough to prevent displacement, but not enough to interfere with quick removal when required for use in case a fire is discovered.

In severe climates, the barrel should contain a brine made up by dissolving 100 lb. of salt in boiling water, which should then be poured into the barrel. In some of the southern states where the climate is not severe, a stick of wood, preferably a 6-in. cube, placed in the barrel will prevent damage to the equipment. After the freezing weather is over, the brine should be emptied, and the barrel should be washed out and painted or greased with a suitable material that will adhere permanently to the metal.

When to Paint Enginehouse Sash

Should sash in enginehouses and shops be painted in the fall or winter? If not, why? If so, what are the advantages?

Must Have Windows Open

By G. S. Crites
Division Engineer, Baltimore & Ohio, Punxsutawney, Pa.

A satisfactory or lasting job of painting sash in enginehouses and shops cannot be accomplished when the openings are not in use for ventilation. When the openings are closed, the inner surfaces of the sash collect moisture which absorb the corrosive elements of the locomotive gases. The result is that the paint will neither cover nor adhere to these surfaces. If the weather in the fall is warm and dry enough to allow free access to the sash from both sides, and the openings can be left open freely, there is no reason why a good job of painting cannot be done at this season. The benefits from painting at this time will extend through the winter, a period when the protection is most needed.

If the winter is cold, the painting of the sash is out of the question. Cold paint applied to cold surfaces, and cold painters, are not conducive to a good job, and unventilated fresh paint blisters and peels. The painting should be done in the summer or early fall, when it can be done in comfort, on dry surfaces, and when ample ventilation is assured.

Better in the Summer

By E. C. Neville
Bridge and Building Master, Canadian National, Toronto, Ont.

Sash in enginehouses can be painted much more economically in the summer, with better results, than in either the fall or winter. During the winter, especially in cold climates, the doors and windows in both enginehouses and shops are kept closed to retain heat, to provide comfortable working conditions and to improve the efficiency of the workmen. Under these conditions, escaping steam from locomotives is confined within the building to a much greater extent than during the summer months when doors and windows are usually wide open for better ventilation. Under these conditions the sash is never thoroughly dry on the inside of the building, and dry surfaces are essential for successful painting.

With low temperatures on the outside and damp surfaces on the inside of the building it is equally impossible to obtain a good job of painting. For this reason, the summer, when temperature and moisture conditions are at their best and are substantially equal both inside and outside of the building, is the best time to do the painting. This is true for both wood and steel sash, for neither type can be painted successfully if the surfaces are damp or frosted. This is also equally true for enginehouses and shops, although the conditions inside the latter are generally better.

It must be admitted that the painting of sash in enginehouses and shops is a job that is seldom welcomed by busy maintenance officers because of its magnitude and the time involved. They often hesitate to undertake it during the summer months when there is so much other work pressing for attention. The usual result is that it is left to be done in the fall or winter, or more often is cut off the list for the year, to be deferred until the following and succeeding seasons. The same thing happens the next year, with the result that the sash deteriorates to the point where renewal becomes necessary.

I consider this to be poor economy.

In general, the painter foreman exhibits no more enthusiasm with respect to painting the sash in engine houses and shops than his superior officers do. For him, it is a tedious and long-drawn-out job upon which it is difficult to show progress or constructive work. He is always being pressed to hurry the completion and

can rarely give a convincing reason why his forces are tied up on this work so long. The mechanical department looks upon the project as an unwarranted interference with their own work and by their complaints add to the foreman's discomfort and exasperation.

Thorough cleaning of the surfaces, both wood and steel, is an important phase of the work preparatory to painting. This is as important as it is for any other surfaces. The areas involved are small and the work of cleaning is tedious, and this is largely the reason for the low rate of progress. Added to this, if the sash is of wood, the putty must be gone over and renewed wherever necessary. Again, all damaged and missing glass must be replaced. Then, when these preparatory items are out of the way, the application of the paint is equally tedious. Taken altogether, it is not difficult to understand why the time consumed in this work is excessive or why the tendency is to sidestep it as long as possible.

Can Salt Be Used on Switches?

Is it advisable to use salt to prevent accumulations of ice around switches? Through interlocking plants? Why? What other means can be employed more advantageously?

Never Advisable

By B. R. Kulp
Engineer of Maintenance, Chicago & North Western, Chicago

It is never advisable to use salt to prevent accumulations of ice around switches or through interlockings, since this practice results in excessive corrosion of the iron and steel parts, such as operating apparatus, bolts, nuts, plates, rods and similar accessories. This corrosion materially shortens the life of this equipment and also interferes with the signal circuits.

At the more important points, where a supply of gas is available, we have obtained excellent results through the use of gas switch heaters for the purpose of melting the snow. This keeps the switches and the interlocking plants in operative condition during ordinary snow storms, with the minimum of hand labor. Electric heaters are similarly used by some roads to keep the switches clear of snow. We have found portable heaters, of which there are several types on the market, to be of distinct advantage at switches where fixed heating equipment has not been installed. Snow-burning oil (light hydrocarbon) and torches of oil-soaked waste, are used frequently at points when burners are not available, and are effective in keeping switches open.

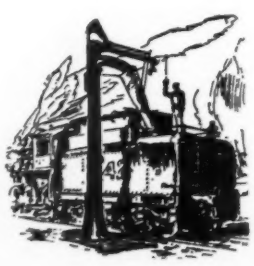
During extremely heavy falls of snow, the snow may reach such depth that any type of flame burner will be unable to keep the switches and interlocking plants open, as locomotives and cars will drag the snow onto the rails and extinguish the flames of the burners. It is then necessary to remove the excess snow with shovels or by other means, before the burners can be relighted.

Foremen Know Value

By John J. Ensign
Assistant Engineer of Track, New York Central, New York

The use of salt to prevent accumulations of ice around switches is a practice of long standing, and few realize how widespread it is. Almost every section foreman of experience knows its value for this purpose, and if he has access to a supply, will use it to prevent switch failures and the labor of chopping the ice. However, there are places where its use should be prohibited, as, for instance, in electrified territory where there is a third rail, or buried cable or conduit. This is also true of interlocking plants, where present practices call for trench-lay cables. The reason for this is that salt is an excellent electrolyte, and since its continued use impregnates the ground, electrolysis results, shortening the life of cables, conduits, etc.

A much more satisfactory method of melting ice around such switches is by means of electric, gas or oil switch heaters, of which many types are available. For yard use, the safety can, burning low-grade casinghead gasoline, is probably the most effective means of clearing ice and snow from around the switches.



For remote switches out on the line, salt handled with discretion can perhaps be used to advantage. Even here, however, one must consider the corrosion of the track fastenings and the switch fixtures, for under some traffic this is considerable and is increased by the use of salt to reduce the accumulation of ice. In remote sections where there is considerable wild life, salt cannot be used, as it attracts deer, and many of these animals may be killed, particularly during the night, when the headlights blind them. In general, while I would not prohibit the use of salt rigidly, I would require that it be used with judgment and under supervision as to location.

Use Sparingly

By J. H. Craig
Signalman, Missouri Pacific, Atchison, Kan.

While salt may be used to advantage in some cases, even around interlockings, its use rarely gives complete satisfaction. It should be scattered over the ground, so that as the ice or snow melts the brine will be carried away through the regular drainage channels. It will be effective for light storms only, because the melting of the snow and ice is a slow process, regardless of the amount of salt used. For this reason, other means must be found to handle accumulations of snow during heavy storms.

If insufficient salt is used, the result will be half-frozen slush, which is more difficult to dispose of than the original snow and ice. Salt should not be allowed to come in contact with the switches or switch fixtures or with any part of an interlocking mechanism, because the resultant corrosion causes lost motion. Furthermore, salt cannot be used between the switch point and the running rail, where snow causes the most trouble.

Once corrosion starts, it is extremely difficult to stop. Even though all visible salt has been removed, enough will still cling to the metal to continue action when any moisture is present. The problem of brine drippings around switches and interlockings is sufficiently serious without the added grief that comes through the deliberate spreading of salt around such important points.

I would recommend the use of any

of the snow-melting devices which are now available for keeping switches clear, particularly where many switches are located. For more isolated turnouts on the line, kerosene or gasoline torches will be effective where shovels and brooms do not always give uniformly satisfactory results.

Finish for Hardwood Floors

What is the most practical finish for hardwood floors in railway offices? In stations? Why?

Oil or Varnish

By Frank R. Judd
Engineer of Buildings, Illinois Central, Chicago

It is the general practice to finish hardwood floors with either oil or varnish for both offices and stations. Linseed oil is used for floors of maple or yellow pine, heating the oil as nearly as possible to the boiling point and applying it while it is at the maximum temperature. Three coats should be applied in this way, allowing sufficient interval between each coat and the succeeding one for absorption by the wood, and drying. The floor should not be used until the third coat has dried thoroughly. This finish is the one more commonly used and is cheaper than other satisfactory finishes.

Varnish can be used for such woods as oak, yellow pine, etc. Oak floors should be given one coat of paste filler, which should be rubbed off before the first coat of varnish is applied. The first coat of varnish should be thinned by adding one pint of turpentine to each gallon of the varnish. The following two coats should be first-quality elastic floor varnish. Each coat should be allowed to dry thoroughly, and after the first coat is dry, it should be sandpapered lightly with a fine sandpaper.

More desirable floors for offices are obtained by using linoleum, while more desirable floors in stations can be obtained for waiting rooms, toilets, etc., with terrazzo or tile.

Does Not Use Oil

By General Inspector of Buildings

The most practical finish for floors in stations and offices will differ with the different kinds of wood that are used for the flooring. It is customary in finishing hardwood floors, to use a paste filler. This may be followed with two coats of liquid filler, containing the desired stain, and when dry, with a coating of wax. Again, the paste filler may be followed by two or three coats of varnish, without the liquid filler. Where a filler is not needed, I suggest shellac as the priming coat, since it does not tend to darken or stain the wood as linseed oil does. In this connection, it should be remembered that varnish contains linseed oil.

For new, rift-sawed or flat-grain, southern pine, two coats of orange shellac make a very satisfactory finish. The first coat should be sandpapered when dry, using a fine sandpaper. This finish can be improved somewhat, however, by sandpapering the second coat lightly with the fine sandpaper and applying one coat of first-grade, dull-finish floor varnish. Another finish for this wood, probably the most desirable for offices, is to use three coats of the best floor varnish obtainable, omitting the shellac. If a high gloss is desired, high-gloss varnish should be applied as the priming coat and, when dry, sandpapered with fine sandpaper, always rubbing with the grain. The second coat should be a dull finish, sandpapered as before. The third coat should be a high-gloss finish. When cleaning floors finished with shellac or varnish, alkali soaps should not be used as they will saponify the oil and ruin the varnish. If it is necessary to use water, it should be used with an oil soap, which contains no alkali.

A natural paste filler should be applied to oak, ash, chestnut or other open-grain woods. If a dark color is desired, a dark filler should be applied, with the usual treatment. If the floor is to be waxed, orange shellac should be applied and sandpapered, then followed by the wax, which should be rubbed to a polish. If the floor is to be varnished, the paste filler should be applied, after which three coats of the best floor varnish obtainable should be applied as described for the southern pine, except that if a dull finish is desired, the final coat should be a dull-finish varnish.

Most of the floors in railway offices are yellow pine, and the procedure outlined for this wood will give the most satisfactory results. Not a few painters advocate an oil finish, a thing I would never consent to as long as the choice is in my hands. It is pertinent to say that whatever finish is decided on, the materials should be the best that can be obtained, for they represent only a small part of the cost.

Value of a Tie Inspector

What are the advantages and disadvantages of employing a tie inspector to determine tie renewals?

Leave to Local Officers

By W. H. Sparks
General Track Inspector, Chesapeake & Ohio, Russell, Ky.

The section foreman knows in more intimate detail all of the conditions that are affecting his track and his maintenance requirements than any one else can possibly know. He knows the condition of his ties; in a general way he knows their age; he has watched their performance, and knows those that must be watched closely; he also knows the places where the requirements can be relaxed somewhat and how far it is safe to go in retaining ties that are nearing the end of their service life. The supervisor or roadmaster is the next best informed on these points. Presumably he is a man of judgment and is acquainted with timber, for these are essential qualifications for his work.

These men are, therefore, better qualified to make the tie inspection than any outside person who is not so intimately familiar with the traffic, ballast, roadbed and other local conditions, no matter how expert he may be with respect to judging timber. I am not blind to the fact that both foremen and supervisors err in their judgment at times, and that no estimate of the ties needed should be accepted without being checked.

This does not mean that the check will require the counting of the ties that are to be renewed on every mile, for if this is to be done the original inspection was a waste of time. Experience has shown that a count on two or three, or in some special cases a few more miles, selected at random, on a su[illegible]'s district, is sufficient to show [illegible]ely whether the original estima[illegible] is correct within close

limits. Obviously, if the results of the original inspection are found to be grossly inaccurate, a new inspection is in order, but in many years of experience I have seen this happen only a few times.

Who should make the check? Checking the tie inspection affords an opportunity for the engineer maintenance of way, the district engineer, the track inspectors, the engineer of track and the division engineer to go over the road together, to observe all structures, such as culverts, bridges, buildings, etc., in addition to the track itself. In this way, these officers, whose duties do not always allow them to come into intimate contact with all of the details of the property at other times, are given an opportunity to see conditions at first hand, and to discuss them on the ground. The higher officers in the department are then in position to answer many questions from first-hand knowledge, that may be asked of them by their superior officers. They can also base later decisions on a better understanding of the problems that are confronting their local officers.

Sees No Advantage

By L. G. Byrd

Supervisor of Bridges and Buildings, Missouri Pacific, Poplar Bluff, Mo.

I see no advantage in employing a tie inspector to determine the following year's tie renewals on a supervisor's or roadmaster's district. The decision as to whether a tie shall be renewed, although sometimes looked upon as a routine matter, is really based on two important considerations —safety and economy. It scarcely needs to be said that a tie that has reached the point where it has ceased to function should be replaced, or that a tie that is still functioning should not be disturbed. It is the border-line cases, that is, ties that are closely approaching the end of their service life, that call for close observation and the exercise of judgment. But judgment is, or should be, based on knowledge, and no one is in better position to know the facts about the ties than the foreman and the supervisor.

Foremen and supervisors are continually inspecting the track, and more frequent and closer inspections to determine what is required by those who are responsible for the upkeep of the track familiarizes them with conditions to such an extent that they are better qualified to know what is needed than one who has not had this advantage. When an outside tie inspector is employed, these officers are in a measure relieved of their responsibility and are made to feel that their dependability is being questioned. It should not be lost sight of that even among the most experienced trackmen there are often wide differences of opinion concerning the desirability of renewing ties that are on the border-line. From my viewpoint the decision should be made by those who are responsible for the safety of the track and the economy with which they maintain it, and should never be left to one, no matter how conscientious he may be, whose interest in the matter ceases when the count has been completed and his report made.

Examining Scrap Shipments

Should the supervisor examine the scrap originating on his district before it is loaded for shipment, to prevent the inclusion of usable material? Why?

Must Avoid Waste

By T. M. Pittman

Division Engineer, Illinois Central, Water Valley, Miss.

One of the most important duties of the supervisor is the handling of his material and, to avoid waste, he must conserve every piece of usable material. All released material should be sorted carefully and separated into three lots, one being material that he can use on his district, another containing usable material that is not likely to be needed on his district within a reasonable time, and the third lot should contain scrap only. All of the material that he has no immediate use for, including obsolete items, should be returned to the storehouse for other disposition. In some cases there is a fourth classification which includes materials that are unfit for use but can be reclaimed.

The inclusion of usable material in scrap is wasteful, but can be avoided only by close supervision, and the supervisor should be satisfied that the various items have been classified correctly. Conditions under which supervisors work are so variable that it is unwise to insist that the supervisor shall personally oversee the sorting of the scrap and usable material every month on every section under his jurisdiction, for, while it might seem that he could do this in connection with his routine work, in many cases it will mean considerable delay either to his other work or in sorting the material.

Every supervisor has some foremen whom he can trust to sort the accumulated material as carefully as he can do it himself, and no good will be accomplished by taking the time regularly to do it for them. General supervision and an occasional visit to oversee the sorting personally should be sufficient with such men. He will also have other foremen who will require close supervision, and it will be necessary for him to inspect or oversee their work in detail. In all events, however, the supervisor should know that the released material has been sorted and classified properly, and to do so he must give the personal attendo so he must give it his personal attention; otherwise he cannot know.

Should Inspect

By W. H. Sparks

General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

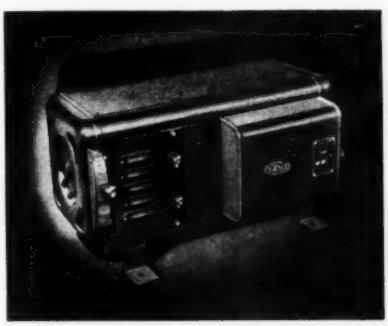
This is a subject that does not always receive the consideration that its importance warrants. While I do not mean to imply that it is being done deliberately, one can go to almost any scrap concentration point and find some usable material and, occasionally, even new unused items. It is generally the material that is close to the border line separating scrap and the items that can be reclaimed that gives the most trouble in making the classifications. We are demanding a great deal from both our supervisory and our maintenance forces in these days, and we can expect that such operations as the sorting of released material will be done perfunctorily at times unless the supervision is close and foremen are trained to use care in making the separations.

Foremen should be trained to pick out such material as is suitable for reuse on the supervisor's district. The supervisor should inspect it and, if he has use for it, send it to the point where it can be used. If he has no immediate use for it, it should be sent to the stores department or the reclamation plant as usable material. The remainder should then be classified and shipped in accordance with instructions. It is the supervisor's responsibility to see that these classifications are made properly and he should not shirk it, but inspect every lot before it is shipped. Laxity in this respect always results in waste.

PRODUCTS of Manufacturers

New Compact Electric Arc Welder

THE Harnischfeger Corporation, Milwaukee, Wis., has developed a P & H Hansen Model WA-200 square frame welder for multi-arc service, which requires less than 3½ sq. ft. of floor space, offers a welding range from 40 to 225 amperes and is designed to produce a high quality welding arc for manual welding service.



The New P. & H. Hansen Model WA-200 Electric Arc Welder

This square frame, rigid welding generator, which retains the characteristics made possible by the Hansen patents which cover automatic volt ampere regulation, self excitation and internal stabilization of the welding current, is built with two main parts; the rugged frame and the rotating member. The frame, which is made of heavy members welded into a single unit, is extremely rigid and is designed to protect bearings against misalignment and wear.

It is said that this rugged construction, coupled with perfect static and dynamic balance of the rotating member, has resulted in elimination of the vibration formerly expected in the ordinary electric arc welder and will greatly increase the life of the welder, minimizing the service requirements throughout its use. The departure from the conventional round type of welding generator, employing a specially designed square frame, permits the units to be mounted one on another for convenient hookup in parallel where a greater output is necessary for heavy welding service.

Duff-Norton Piling Puller

THE Duff-Norton Manufacturing Company, Pittsburgh, Pa., has placed on the market a device for pulling wood sheet piling or shoring, which is known as the Duff-Norton Piling Puller. This unit consists essentially of a specially-designed clamp, one jaw of which is rigid with a flat surface while the other embodies a revolvable member. One side of this member has a curved face with corrugation-like teeth while on the opposite side a lifting ring is provided. In operation the puller is placed over the sheet pile and the lifting force is applied through the ring by a crane or jack. This causes the teeth to bite into the timber so that a firm grip is obtained on the member being pulled. This device may be used for pulling piling up to 2½ in. in thickness.

Illustrating the Manner in Which the Piling Puller Is Used With a Jack

New Books

A Fieldbook on Decay in Timber

RAILROAD TIE DECAY, by C. J. Humphrey and C. Audrey Richards. 5⅝ in. by 9¼ in., 55 pages. Bound in flexible cloth. Published by the American Wood-Preservers' Association, 1427 Eye street, N. W., Washington, D. C. Price $2.

In part, this volume is a reprinting of the book originally issued by the association in 1920, and which has been out of print for several years, containing a discussion of the Decay of Ties in Storage, by C. J. Humphrey, pathologist, U. S. Bureau of Plant Industry, to which has been added the more recent discussion of Defects in Crossties, Caused by Fungi, by C. Audrey Richards, pathologist, Division of Forest Pathology, Bureau of Plant Industry.

This volume contains the most complete and practical information in print for the use of railway timber inspectors and engineers who are confronted with problems connected with the handling and seasoning of timbers. It describes and illustrates 52 of the more common fungi that are likely to be found on hardwoods and coniferous timbers in the United States. It explains how timbers become infected, the conditions which favor and retard decay, and the manner in which decay progresses. The brief descriptions of these fungi are concise and non-technical and are accompanied by a simple key by which each species can be identified.

NEWS of the Month

Shirley N. Mills Appointed Director of Bureau of Safety

Shirley N. Mills, assistant director of the Interstate Commerce Commission's Bureau of Safety since 1919, has been appointed director of that bureau to succeed W. J. Patterson, who was appointed a member of the Interstate Commerce Commission as reported in the September issue.

Railroads Order Large Number of Freight Cars

In September Class I railroads placed orders for 16,497 new freight cars, which exceeded by 1,793 cars the number of new freight cars put in service in the first nine months of this year. New freight cars placed in service ordered by Class I railroads in the first nine months of this year totaled 37,757. Of that number 14,704 have been put in service since the first of the year and 23,053 were on order on October 1.

Railroad Employment Continues Increase

During the one-month period from mid-August to mid September, railroad employment increased from 1,004,619 to 1,019,063, according to the Interstate Commerce Commission. The increase as compared with September, 1938, was 5.77 per cent, while the index number, based on the 1923-25 average as 100 and corrected for seasonal variation, stood at 55.9, as compared with 54.9 in August and 52.9 in September last year.

Freight Car Loadings Increase

For the week ending October 14, the loading of revenue freight amounted to 844,955 cars, the greatest number since November 15, 1930, according to reports released by the Association of American Railroads on October 19. This was an increase of 10,261 cars or 1.2 per cent above the preceding week, an increase of 118,813 cars, or 16.4 per cent above the corresponding week in 1938, and an increase of 38,860 cars or 4.8 per cent more than the same week in 1937.

Towns Refuse Bus Permit, Fear Loss of Railroad

A petition for authority to operate a motor bus line between Rochester, N.Y., and Mount Morris was denied recently by the New York Public Service Commission, chiefly because three towns and two villages denied petitions for local consents. The basis for their refusal apparently lay in a desire to preserve passenger service on the 34-mile Rochester branch of the Erie, which parallels the proposed bus route almost throughout.

More Rail Orders

Since September 2 an unprecedented volume of rail orders have been placed with the steel mills for such a short period of time. The total rail orders placed during this period, amounting to nearly 721,000 tons, indicate a year of greatly increased maintenance activity for the railroads in 1940. The rail orders placed since September 2, by the various roads, in addition to the 188,854 tons reported in the October issue, are as follows:

	Tons Ordered
Atchison, Topeka & Santa Fe	69,700
Baltimore & Ohio	25,000
Central of Georgia	4,250
Chicago & North Western	22,000
Chicago, Burlington & Quincy	30,000
Chicago Great Western	5,000
Chicago, Milwaukee, St. Paul & Pacific	30,000
Chicago, Rock Island & Pacific	16,000
Erie	17,425
Illinois Central	20,100
Missouri Pacific	38,855
Nashville, Chattanooga & St. Louis	2,400
New York, New Haven & Hartford	6,528
Norfolk & Western	25,000
Northern Pacific	35,600
St. Louis-San Francisco	16,750
Southern Pacific	60,000
Spokane, Portland & Seattle	10,000
Union Pacific	87,500
Wabash	10,000
Total	532,108
Total Orders Since September 2	720,962

Beven Says Rails Lacking Only in Equipment

J. L. Beven, president of the Illinois Central, in an address entitled "The Railroads at Work," presented at the annual transportation luncheon of the Illinois Chamber of Commerce at Chicago on October 12, discussed the ability of the railroads to take care of the increased demands for transportation which may develop. Mr. Beven expressed the view that the roadbed and maintenance facilities of the railroads were ample to take care of the increased traffic and that they were in better shape than most people realized, in spite of reduced expenditures during the past decade, because of the use of improved materials, machinery and methods in maintenance and construction work. With regard to rolling stock, M. Beven said, "We are obviously faced with certain present deficiencies for handling further large increases in traffic volume. . . . I also think that we are in better shape for rolling stock than some people think. . . . We have fewer cars but they are bigger and better cars. We have fewer locomotives than we once had, but present locomotives have more pulling power on the average. . . . Furthermore, the movement of freight has been speeded up. . . . I believe the estimate is sound, that because of these and other improvements it would be possible to handle the 1929 volume of business with 350,000 fewer cars than were used in that year or the 1918 volume of business with 600,000 fewer cars than were used in that year.

Grade Crossing Accidents Decrease

In the first half of 1939, fatalities resulting from highway-railroad grade crossing accidents totaled 680, a decrease of 16 fatalities compared with the corresponding period of last year and in the first six months of this year, 1,846 persons were injured in such accidents, compared with 1,962 in the corresponding period of 1938. Accidents at highway-railroad grade crossings during this period totaled 1,605, a decrease of 46 compared with the same period last year.

President Has Power to Take Over the Railroads

According to Attorney General Murphy in a recent letter responding to a Senate resolution calling for information as to the extraordinary powers available to the President during a national emergency or state of war, the President is authorized by the Act of August 29, 1916, to take possession and assume control of any system or systems of transportation or any part thereof "in time of war." Other acts provide for preference to shipments of troops and materials of war upon demand of the President "in time of war or threatened war" and authorize the Interstate Commerce Commission to direct preferences and priorities upon certification of the President that such preferences and priorities are essential to the national defense and security "in time of war or threatened war."

Association News

Metropolitan Maintenance of Way Club

The club held its first meeting of the year on October 26, at the Governor Clinton hotel, New York. The speaker was G. J. Ray, vice-president in charge of operation of the Delaware, Lackawanna & Western, who spoke informally on the subject "War As It Affects Track Maintenance." In accordance with past practice, the next meeting of the club will be held on the afternoon of the day on which the New York Railroad Club holds it annual dinner, which will be on December 7, 1939.

Wood-Preservers' Association

At a meeting of the Executive Committee at Cincinnati, Ohio, on October 6, W. J. Burton was appointed representative on the American Standards Association's Sectional Committee on Specifications for Crossties and Switch Ties, filling a position that has been vacant since the death of Earl Stimson some years ago. At this meeting plans were formulated for the program for the annual convention to be held in St. Louis, Mo., on January 23-25, and especially for the Users Day session on Wednesday forenoon of that week. Arrangements are being made for members along the Atlantic seaboard to travel to the convention in a group on a route to be selected by the Transportation Committee.

Maintenance of Way Club of Chicago

One hundred eighteen members and guests were present at the first meeting of the season of the Maintenance of Way Club of Chicago, which was held in the Auditorium Hotel on the evening of October 23. The speaker was C. A. Morse, retired chief engineer of the Chicago, Rock Island & Pacific, formerly chief engineer of the Atchison, Topeka & Santa Fe, and formerly assistant director of operation, in charge of maintenance of way, United States Railroad Administration. His subject was Maintenance of Way Problems in Times of National Emergency, and he reviewed the relations of the administration to the railways and the developments with respect to maintenance of way which resulted from the administration's activities. The next meeting of the Club will be November 27.

Meeting Held on Consolidation of Exhibits

A luncheon meeting of representatives of the American Railway Engineering Association, the Roadmasters and Maintenance of Way Association, the American Railway Bridge and Building Association and the Signal Section, A. A. R., with representatives of the railway supply associations interested in and exhibiting at the conventions of these organizations, was held at the Hotel Stevens, Chicago, on September 18. The meeting was called by E. D. Cowlin, chairman of the Committee for the Consolidation of Railway Supply Associations, who outlined the hope of the supply associations that some plan could be developed which would permit the manufacturers to present one consolidated exhibit for the members of these various associations. Since the success of this plan depends upon the cooperation of the railway associations in adjusting their conventions to meet at approximately the same time, a committee of representatives of these railway associations was appointed with F. R. Layng, chief engineer, B. & L. E., and a representative of the A.R.E.A. as chairman to consider the proposal from the standpoint of the railway associations.

American Railway Engineering Association

The Board of Direction met in Chicago on October 25. At this meeting the Board approved the revision and publication of the complete set of trackwork plans, about 40 of which will be submitted for adoption at the next convention. The Track committee hopes to revise all of the remainder and complete such new plans as it now has under consideration, in time for submisison to the 1941 convention.

The Board also authorized the re-establishment of Committee 24, Co-operative Relations with Colleges and Universities.

Concurrently with the meeting of the Board, the Nominating committee met to consider nominations for officers for next year, and these will be announced later.

Five committee reports are now in the hands of the secretary and three more are promised for early in November. These will appear in Bulletin 413 which will be mailed to members prior to December 1.

Nine committes held meetings in October, two of which will extend over into November. These include Iron and Steel Structures, at Washington, D.C., on October 5 and 6; Waterways and Harbors, at Milwaukee, Wis., on October 6; Waterproofing of Railway Structures, at New York, on October 11 and 12; Water Service, Fire Protection and Sanitation, at Chicago, on October 18; Wood Bridges and Trestles, at Chicago, on October 19; Rules and Organization, at Chicago, on October 24; Impact, at Chicago, on October 24; Records and Accounts, at Chicago on October 31 and November 1. The Committee on Ties met at Macon, Ga., on October 31, going from there to Atlanta the same day. The plans for the meeting include a trip from Atlanta to Montgomery, Ala., on November 1, and a continuation of the meeting at Montgomery on November 2, the purpose of this meeting being to observe ties on the Central of Georgia, the Seaboard Air Line and the Louisville & Nashville.

In addition to these two meetings that are to extend over into November, three committees have meetings scheduled for this month, these being Economics of Railway Labor, at St. Louis, Mo., on November 2; Masonry, at Chicago, on November 9 and 10; and Track, at Chicago, on November 15.

Personal Mention

General

Harold Filskov, assistant superintendent of the Raritan River railroad, has been appointed manager in charge of operation and maintenance, with headquarters as before at South Amboy, N. J., succeeding **Thorvald Filskov,** superintendent and chief engineer, who has retired after more than 40 years of service with this company.

J. E. Rogan, division engineer on the Illinois Central, with headquarters at McComb, Miss., has been promoted to trainmaster of the New Orleans Terminal, with headquarters at New Orleans, La., a newly created position.

Mr. Rogan was born at New Orleans, La., on November 3, 1886, and graduated in civil engineering from Tulane University in 1907. He entered railway service in June of that year as a section and construction foreman on the Illinois Cen-

John E. Rogan

tral and in September, 1913, he was promoted to track supervisor, with headquarters at New Orleans, La. In February, 1919, Mr. Rogan was advanced to division engineer of the New Orleans Terminals and in September, 1931, his jurisdiction was enlarged to include the Louisiana division and the Gulf & Ship Island (part of the Illinois-Central system). His appointment as trainmaster was effective October 1.

John M. Ryan, whose promotion to assistant to the general manager of the Nashville, Chattanooga & St. Louis, with headquarters at Nashville, Tenn,. was announced in the October issue, was born at Nashville, Tenn., on August 23, 1886, and attended Vanderbilt University. He entered railway service on August 4, 1908, as a rodman in the engineering department of the Nashville, Chattanooga & St. Louis and in 1909 he was appointed a draftsman. Mr. Ryan was promoted to assistant engineer on the Huntsville division in 1910, and was transferred to the Nashville division in 1911. Early in 1914, he was appointed assistant to the engineer maintenance of way, and later that year he was promoted to division engineer of

the Nashville division, with headquarters at Nashville, Tenn. In 1937, his jurisdiction was extended to include the Paducah and Memphis divisions. His promotion to assistant to general manager was effective September 1.

William H. Hillis, engineer maintenance of way of the Chicago, Rock Island & Pacific, has been promoted to assistant chief operating officer, a new position, with headquarters, as before, at Chicago, and with jurisdiction over the engineering, construction and maintenance of way departments of the system.

Mr. Hillis was born at Colona, Ill., on March 31, 1886, and entered railway service on January 1, 1906, as a rodman on the Chicago, Burlington & Quincy at Beardstown, Ill. He later served in various capacities in the engineering department on that railway until August 15, 1911, when he was appointed a roadmaster, and during the following five years served in that position on various divisions, then being transferred to the operating department as trainmaster on the Aurora division. In 1925, Mr. Hillis was appointed district engineer of maintenance of the Illinois district, with headquarters at Galesburg, Ill., and in October, 1927, he was advanced to assistant superintendent of the LaCrosse division. Three years later he was transferred to the Galesburg division, and on December 15, 1931, he was sent to Texas where, as superintendent of construction, he had charge of the construction of a 110-mile line between Childress, Tex., and Pampa. Following the completion of this work, Mr. Hillis returned to the LaCrosse division as assistant superintendent. In July, 1936, Mr. Hillis resigned that position to become engineer maintenance of way of the Rock Island, with headquarters at Chicago.

William H. Hillis

Werter S. Hackworth, assistant real estate agent of the Nashville, Chattanooga & St. Louis, with headquarters at Nashville, Tenn., and an engineer by training and experience, has been promoted to assistant to the president, with the same headquarters. Mr. Hackworth was born at South Pittsburg, Tenn., on July 14, 1896, and graduated in civil engineering from the Alabama Polytechnic Institute on June 16, 1916. One month later he entered railway service as a track laborer on the N. C. & St. L. and on September 15, 1916, he was appointed instrumentman on the Chattanooga division. Mr. Hackworth was promoted to assistant division engineer of the Huntsville division on February 1, 1917, and on May 28, 1917, he enlisted in the U. S. Army, serving in France with the 17th Engineers. After his discharge from the army, he served from June, 1919, until October, 1920, as city engineer of South Pittsburg, returning to the N. C. & St. L. on the latter date as a rodman on the Atlanta division. In June, 1921, he went with the Louisville & Nashville as a draftsman on a locating party and returned to the N. C. & St. L. in January, 1922, as an assistant engineer in the chief engineer's office at Nashville. In January, 1926, Mr. Hackworth was appointed assistant division engineer of the Atlanta division, but left the N. C. & St. L. again on December 31, 1931, serving as a coal salesman for the Whitwell Coal Corporation in Atlanta, Ga., until January 1, 1933, when he became superintendent of dairies for the State of Georgia. On September 1, 1933, he returned to the N. C. & St. L., as assistant engineer in the real estate department and was later appointed assistant real estate agent, the position he held until his recent promotion.

Engineering

D. F. Apple, supervisor of track on the Chesapeake & Ohio, with headquarters at Thurmond, W. Va., has been appointed assistant division engineer, with headquarters at Covington, Ky.

H. L. Barr, assistant engineer on the Chicago & North Western at Huron, S. D., has been promoted to division engineer, with headquarters at Chadron, Neb., succeeding **D. C. Barrett,** who has been transferred to Norfolk, Neb. Mr. Barrett relieves **C. F. Womeldorf,** who will retire on November 1.

A. A. Winter, engineer of the Atlanta & Saint Andrews Bay, has been appointed to the newly-created position of chief engineer in charge of roadway matters, with headquarters as before at Dothan, Ala. Mr. Winter was appointed to this position following the resignation, on August 21, of **Whit Land,** roadmaster.

H. F. Whitmore, assistant district engineer of the Lake Erie and Western district of the New York, Chicago & St. Louis (Nickel Plate) with headquarters at Frankfort, Ind., has been promoted to division engineer of the Clover Leaf district with the same headquarters, succeeding **H. M. Hockman,** whose death on September 4 is announced elsewhere in these columns.

C. I. Van Arsdalen, track supervisor on the Illinois Central at Champaign, Ill., has been promoted to division engineer of the St. Louis division, with headquarters at Carbondale, Ill., succeeding **W. R. Gillam,** who has been transferred to the Illinois division, with headquarters at Champaign. Mr. Gillam replaces **C. J. Harrington,** whose death on September 29 is announced elsewhere in this issue.

Frank W. Thompson, division engineer on the Chicago, Rock Island & Pacific, with headquarters at Rock Island, Ill., has been promoted to engineer officer, with headquarters at Chicago, a newly created position, with jurisdiction over all employees in the engineering department, except those reporting to the engineer of bridges. **F. P. Funda,** division engineer, with headquarters at Kansas City, Mo., has been transferred to Rock Island, succeeding Mr. Thompson, and **J. T. Fitzgerald,** roadmaster at Topeka, Kan., has been promoted to division engineer at Kansas City, replacing Mr. Funda.

Mr. Thompson was born at Silver Cliff, Colo., on January 26, 1881, and attended the University of Kansas for five years. He entered railway service on July 1, 1899, as a levelman on the Rock Island at Kansas City, Mo., returning to school that fall. On July 6, 1903, he was appointed draftsman and estimator on the Rock Island at Kansas City. During the next few years he served as draftsman, instrumentman and transitman at various points on the Rock Island, and on October 30, 1907, he was transferred to Chicago on office work and drafting. Mr. Thompson was promoted to assistant office engineer on August 2, 1908, and on December 17, 1909, he was appointed assistant engineer at Davenport, Iowa. On February 1, 1911, he was advanced to division engineer, with headquarters at Des Moines, Iowa, and on January 1, 1929, he was transferred to Rock Island, Ill., where he was located at the time of his recent promotion.

Frank W. Thompson

J. L. Cranwell, division engineer of the Columbus division of the Pennsylvania, with headquarters at Columbus, Ohio, has been transferred to Pittsburgh, Pa., succeeding **J. E. Vandling,** whose promotion to superintendent of the Erie & Ashtabula division, with headquarters at New Castle, Pa., was announced in the October issue, and **A. J. Greenough,** supervisor of track, with headquarters at New Brunswick, N. J., has been promoted to division engineer, with headquarters at Columbus, Ohio, replacing Mr. Cranwell.

Mr. Greenough was born in San Francisco, Cal., on September 20, 1905, and attended Union College, Schenectady, N. Y. He entered railway service on July 1, 1928, as an assistant on the engineering corps of the New York division, later being transferred to Lancaster, Pa. In March, 1929, he was promoted to assistant

supervisor of track at York, Pa., and in August, 1929, he was transferred to South Philadelphia, Pa. In February, 1931, he was transferred to the Middle division at Lewistown, Pa., and in September, 1933, he was promoted to supervisor of track on the Cincinnati division, with headquarters at Anderson, Ind. Mr. Greenough was transferred to Harrisburg, Pa., in November, 1934, and to the New York division, with headquarters at New Brunswick, N. J., in January, 1936, where he was located until his recent promotion.

John R. Caswell, division engineer of the Smith's Falls division of the Quebec district of the Canadian Pacific, with headquarters at Smith's Falls, Ont., has been appointed acting assistant district engineer of the Ontario district, with headquarters at Toronto, Ont., effective August 24. Mr. Caswell replaces **A. O. Wolff,** who had previously been appointed acting district engineer of the New Brunswick district, with headquarters at St. John, N.B., succeeding **C. C. Kirby,** who had been granted a leave of absence because of ill health. **Walter R. Benny,** assistant engineer in the office of the engineer maintenance of way at Toronto, has been appointed division engineer of the Schreiber division of the Algoma district, with headquarters at Schreiber, Ont., succeeding **J. G. Sutherland,** who has been transferred to the Smith's Falls division, as noted in the October issue.

H. R. Davis, supervisor of track on the Illinois Central at Harriston, Miss., has been promoted to division engineer, with headquarters at Vicksburg, Miss., succeeding **S. C. Jump,** who has been transferred to McComb, Miss., replacing **J. E. Rogan,** whose promotion to trainmaster

H. R. Davis

at New Orleans, La., is announced elsewhere in these columns.

Mr. Davis was born at Dyersville, Iowa, on November 15, 1882, and attended Cornell College and the State University of Iowa, graduating in civil engineering from the latter in 1906. He entered railway service almost immediately with the Illinois Central as a chainman in the construction department and in December, 1907, he was promoted to rodman, serving on the southern lines of the I. C. until December, 1910, when he was promoted to instrumentman on the New Orleans division of the Yazoo & Mississippi Valley (part of the Illinois Central) at Vicksburg, Miss. In November, 1913, he was appointed resident engineer at Baton Rouge, La., and in September, 1914, he returned to Vicksburg as an assistant engineer. He held this position for 11 years, being promoted on October 1, 1925, to track supervisor at Harriston, Miss. On December 1, 1929, Mr. Davis was advanced to division engineer, with headquarters at Greenville, Miss., and in March, 1931, due to a consolidation of divisions, he was reappointed track supervisor at Harriston.

R. L. Schmid, whose appointment as principal assistant engineer of the Nashville, Chattanooga & St. Louis, with headquarters at Nashville, Tenn., was announced in the October issue, was born at Louisville, Ky., on March 20, 1886, and attended the college of engineering of Kentucky State University from 1907 to 1910. He entered railway service in February, 1906, when he was employed as a rodman on the Louisville & Nashville. He served in the engineering department of the Penn Tunnel and Terminal Railroad in 1909, returning to the engineering department of the L. & N. in 1910. He entered the service of the Nashville, Chattanooga & St. Louis in 1915 as a pilot on valuation work, and was promoted to resident engineer on construction in 1916. Mr. Schmid was promoted to assistant engineer, with special assignments, in 1918, and to assistant division engineer of the Chattanooga division in 1919. He was advanced to division engineer of the Atlanta division in 1920, and in January, 1926, he was promoted to assistant to the general manager, with headquarters at Nashville, holding that position until his recent appointment.

Harry Bell Reinsagen, whose retirement on October 1 as assistant chief engineer on the New York Central, Lines West of Buffalo, with headquarters at Cleveland, Ohio, was announced in the October issue, was born at Cincinnati, Ohio, on September 17, 1872, and entered railway service on January 1, 1897, as an assistant engineer on the Lake Erie & Western (now part of the Nickel Plate). On January 1, 1906, he went with the Lake Shore & Michigan Southern (now part of the New York Central) as an assistant engineer and on January 1, 1910, he was promoted to first assistant engineer, with headquarters at Cleveland. Mr. Reinsagen was advanced to principal assistant engineer on September 1, 1912, and retained that position when the L. S. & M. S. was merged with the New York Central. On March 1, 1917, he was appointed engineer of maintenance of way, Lines West of Buffalo, with headquarters as before at Cleveland, and on March 16, 1921, he was reappointed principal assistant engineer at Cleveland. Mr. Reinsagen was promoted to assistant chief engineer on July 1, 1929, and continued in that position until his retirement.

Otto Joslin, whose promotion to senior assistant engineer of the Nashville, Chattanooga & St. Louis, with headquarters at Nashville, Tenn., was announced in the October issue, was born in Dickson County, Tenn., on June 4, 1889, and received his engineering education at Vanderbilt University, Nashville, Tenn. (1907-1910). During the summer and fall of 1909 he served as a rodman on location surveys for the Nashville, Chattanooga & St. Louis, and on leaving school in June of the following year he re-entered the service of this company, serving as a rodman on maintenance, location and construction until September, 1911, when he was promoted to instrumentman on the construction of second track. Three years later Mr. Joslin was further promoted to assistant engineer, holding this position on location and construction until June, 1918, when he was transferred to estimating and designing work with the same title. From June, 1920 to July, 1931, Mr. Joslin held the position of supervising engineer in charge of construction, the policy of the company being to carry out practically all construction work with company forces. In July, 1931, Mr. Joslin was appointed track supervisor on the Paducah and Memphis division at Jackson, Tenn., and in February, 1937, he was appointed bridge and building supervisor, with headquarters at Nashville, the position he held until his recent promotion.

Otto Joslin

John B. Whiting, whose promotion to division engineer on the Chicago, Rock Island & Pacific, with headquarters at Des Moines, Iowa, was announced in the October issue, was born at Winterset, Iowa, on April 13, 1895, and entered railway service in June, 1912, as a chainman in the engineering department of the Rock Island at Des Moines during the summer vacation period. From December, 1916 to April, 1917, he served the Chicago & North Western, leaving that road to enlist in the U. S. Army. On August 19, 1919, he returned to the Rock Island as a rodman at Des Moines and on March 20, 1922, he was appointed a masonry inspector at Rock Island, Ill. Mr. Whiting was transferred to Fairbury, Neb., as a rodman on September 18, 1923, and on November 18, 1923, he was promoted to instrumentman at Trenton, Mo. He was further advanced to assistant engineer at Trenton on April 1, 1929, and from August 14, 1930 to September 16, 1930, he served as acting roadmaster at Phillipsburg, Kan., returning on the latter date to Trenton as assistant division engineer. Mr. Whiting was promoted to master

carpenter, with headquarters at Kansas City, Mo., on June, 1936, and held that position until his recent promotion which was effective September 1.

Robert H. Ford, chief engineer of the Chicago, Rock Island & Pacific, with headquarters at Chicago, retired on September 30, after 47 years railroad service. He was born at St. Albans, Vt., on September 8, 1869, and was educated in Norwich University, Northfield, Vt., graduating in 1892. He entered railroad service in the same year with the Central Vermont, with which road he served for 13 years as a roadmaster and in other capacities on construction and maintenance. In 1906, Mr. Ford left this company to go with the Missouri Pacific as an assistant engineer, later being appointed maintenance of way inspector. In 1907, he was promoted to principal assistant engineer, and in 1909 he was further advanced to assistant to the chief engineer maintenance of way. Resigning from the Missouri Pacific in 1911, Mr. Ford joined the Hodges-Downey Construction Company, Birmingham, Ala., general contractors, as chief engineer. In 1913, he left this company to go with the Rock Island as a special engineer, being appointed engineer track elevation in the following year, in charge especially of the large program of grade separation in Chicago. In 1919, Mr. Ford was promoted to principal assistant engineer, and in 1924, he was further advanced to assistant chief engineer. Mr. Ford was appointed chief engineer of the Rock Island on April 1, 1937, holding that position until his retirement. During his career, Mr. Ford had given much time to the broader aspects of transportation engineering, especially in relation to the effect on the railways of the development of the system of inland waterways in the Mississippi Valley. Mr. Ford has also been active in the affairs of the American Railway Engineering Association, having served as its president and as chairman of the Engineering division of the Association of American Railroads in 1935-36. He has also served as chairman of various committees of the A.R.E.A., including the Committee on Co-operative Relations with Universities and Colleges. Mr. Ford has been a member of the board of trustees of Norwich University for a number of years, and that institution conferred upon him the honorary degree of Doctor of Engineering in 1939.

Robert H. Ford

The jurisdiction of **George H. Harris,** chief engineer of the territory embracing the Canada, Detroit, Michigan and West divisions of the New York Central System, has been extended to include the Erie, Cleveland, Toledo, Western and Ohio Central divisions, formerly under the jurisdiction of **R. O. Rote,** who has been appointed assistant to the general manager of the New York Central, with headquarters as before at Cleveland, Ohio, and the headquarters of Mr. Harris have been transferred from Detroit, Mich., to Chicago. **Frank J. Jerome,** engineer of maintenance of way of the Michigan Central, with headquarters at Detroit, has been appointed assistant chief engineer, with headquarters at Chicago. **William O. Houston,** division engineer on the Michigan Central, with headquarters at Jackson, Mich., has been appointed district engineer in charge of engineering and maintenance on the New York Central System in the territory embracing the Canada, Detroit, Michigan and West divisions, with headquarters at Detroit, Mich., and **James A. Stocker,** principal assistant engineer on the New York Central, Lines West of Buffalo and the Ohio Central lines, with headquarters at Cleveland, Ohio, has been appointed district engineer in charge of engineering and maintenance on the New York Central System in the territory embracing the Erie, Cleveland, Toledo, Western and Ohio Central divisions, with headquarters as before at Cleveland. **Arthur P. Button,** engineer of grade crossings on the New York Central, with headquarters at Cleveland, has been transferred to Chicago, and his jurisdiction has been enlarged to include the Canada, Detroit, Michigan and West divisions. **Foster H. Simpson,** assistant engineer on the New York Central, Lines East of Buffalo, with headquarters at New York, has been appointed assistant district engineer, with headquarters at Detroit, Mich., and **Charles R. Strattman,** supervisor of track on the Michigan Central at Lansing, Mich., has been promoted to division engineer, with headquarters at Jackson, Mich., succeeding Mr. Houston.

George H. Harris

Mr. Harris was born at Toledo, Ohio, on July 17, 1878, and received his engineering education at the University of Michigan. He entered railway service in 1901 on the construction of the Detroit and Toledo Shore Line, and in 1902, he became an assistant on the engineering corps of the Pennsylvania at Chicago. A year later, Mr. Harris joined the engineering organization of the Michigan Central as an assistant engineer, and in 1905 he was promoted to division engineer, with headquarters at Niles, Mich., but was reappointed assistant engineer, with headquarters at Detroit, a year later. From 1907 to 1910, he was assistant engineer in charge of the grade separation project of the Michigan Central and the Chicago, Rock Island & Pacific at Joliet, Ill., and on the latter date, he was promoted to division engineer at St. Thomas, Ont. In 1912, Mr. Harris was transferred to Detroit, and in 1913, he was appointed engineer of track, which position he held for three years before being advanced to engineer maintenance of way. During the period between 1917 and 1919, he was acting assistant chief engineer, and in the latter year was appointed special engineer. He served as engineer maintenance of way in 1920-1921 and was promoted to assistant chief engineer in the latter year. On November 1, 1931, Mr. Harris was promoted to chief engineer of the Michigan Central, with headquarters at Detroit, and held this position until his recent appointment as chief engineer on the New York Central System, with headquarters at Chicago.

Mr. Jerome was born at Painesville, Ohio on May 26, 1890, and graduated from Williams College in 1911, and from Massachusetts Institute of Technology in 1914. He entered railway service with the New York Central on July 6, 1914, as a transitman at Elyria, Ohio, and in March of the following year he was transferred to Toledo, Ohio. In 1917, he was appointed assistant engineer at Chicago, and on August 20, 1923, he was promoted to trainmaster at that point. Mr. Jerome was appointed division engineer, with headquarters at Chicago, on November 1, 1927, and in April, 1938, he was promoted to engineer maintenance of way on the Michigan Central, with headquarters at Detroit, Mich., holding this position until his recent appointment.

Frank J. Jerome

Mr. Houston was born at Burlington,

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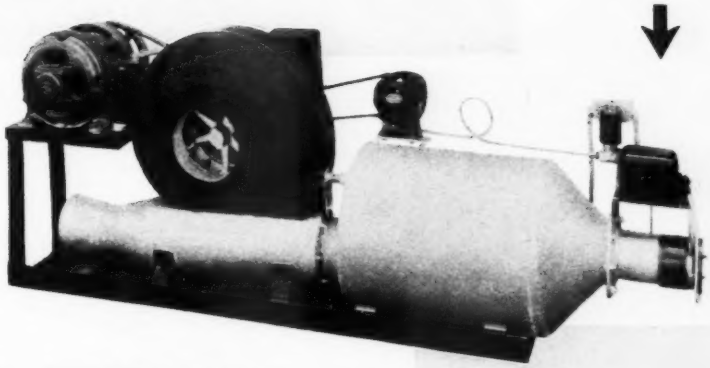

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Kan., and graduated in civil engineering from the University of Michigan in 1904. He first entered railway service during summer vacations while attending school, on the engineering corps of the Ann Arbor and the Michigan Central. Upon graduation, Mr. Houston entered the service of the Michigan Central as an instrument man. On January 1, 1905, he went with the New Orleans Great Northern (now a part of the Gulf, Mobile &

William O. Houston

Northern) as a transitman on location, and later became bridge inspector, resident engineer and division engineer. In April, 1909, he returned to the Michigan Central as assistant engineer in charge of the construction of the yard and tunnel approach at Windsor, Ont. In April, 1910, Mr. Houston went with the Nevada Central as a special engineer in charge of repair of a line which had been badly washed out by flood, and three months later he returned to the Michigan Central as assistant engineer at St. Thomas, Ont. In May, 1912, he was appointed construction engineer at Detroit, and a month later he was promoted to division engineer, with headquarters at St. Thomas. In September, 1913, Mr. Houston was

James A. Stocker

transferred to Jackson, Mich., where he remained as division engineer until his recent promotion, which was effective October 1.

Mr. Stocker was born at Gnadenhutten, Ohio, on April 11, 1875, and graduated in civil engineering from Ohio State University in June, 1902. He entered railway service in October, 1902, as a rodman on the Kanawha & Michigan (now part of the New York Central System) at Charleston, W. Va. On February 1, 1907, he was promoted to division engineer, with headquarters at Charleston, and one year later he went with the Marietta, Columbia & Cleveland (now abandoned) as superintendent and engineer, with headquarters at Marietta, Ohio. On May 1, 1908, Mr. Stocker was appointed engineer of construction of the Toledo & Ohio Central and the Hocking Valley, with headquarters at Columbus, Ohio, and on February 1, 1910, he was promoted to chief engineer of the Ohio Central lines of the New York Central, with headquarters at Columbus, Ohio. On November 1, 1931, Mr. Stocker was appointed engineer of construction of the Lines West of Buffalo and of the Ohio Central lines with headquarters at Cleveland, Ohio, the position he held until his recent appointment.

Track

The headquarters of **G. C. Harris,** roadmaster on the St. Louis-San Francisco have been transferred from Joplin, Mo., to Neodesha, Kan.

T. L. Robinson has been appointed supervisor of track of the Atlanta & Saint Andrews Bay, with headquarters at Dothan, Ala.

S. J. Hendrix, roadmaster on the St. Louis-San Francisco at Tulsa, Okla., has been transferred to Poplar Bluff, Mo., replacing **L. D. Gardner,** who has been transferred to Tulsa.

R. A. Johnson has been appointed roadmaster on the Atchison, Topeka & Santa Fe at Parker, Ariz., succeeding **O. D. Hoge,** who has been appointed roadmaster, with headquarters at Needles, Cal.

W. F. March, track supervisor on the Chicago, Rock Island & Pacific at Columbus Junction, Iowa, has been promoted to assistant roadmaster, with headquarters at Rock Island, Ill., a newly created position.

E. T. Olson, extra gang foreman on the Cochrane division of the Canadian National, has been promoted to roadmaster on the Capreol division, with headquarters at Capreol, Ont., to succeed **H. Jacklin,** resigned.

E. E. Pruitt, roadmaster on the St. Louis-San Francisco, with headquarters at Cherokee, Kan., has been transferred to Ft. Scott, Kan., relieving **Walter Marsh,** who has been granted a leave of absence because of sickness, and **C. L. Elliott,** has been appointed acting roadmaster at Cherokee, replacing Mr. Pruitt.

P. J. Fox, a track foreman on the New York Central, has been promoted to assistant supervisor of track of Sub-Division No. 15 of the Buffalo division, with headquarters at North Tonawanda, N. Y., to succeed **M. Gawron,** who has retired.

E. C. Mingus, roadmaster on the Chicago, Rock Island & Pacific at Little Rock, Ark., has been transferred to Topeka, Kan., relieving **J. T. Fitzgerald,** whose promotion to division engineer, with headquarters at Kansas City, Mo., is announced elsewhere in these columns and **S. T. Robertson,** roadmaster at Chickasha, Okla., has been transferred to Little Rock, replacing Mr. Mingus. **Belshur Bristow,** track supervisor at Little Rock, has been appointed acting roadmaster at Chickasha, relieving Mr. Robertson.

Leemon W. Hollifield, whose promotion to track supervisor on the Louisville & Nashville, with headquarters at Corbin, Ky., was announced in the September issue, was born at Artemus, Ky., on July 9, 1900, and entered railway service on July 9, 1914, as a section laborer at Artemus. On June 18, 1918, he was promoted to apprentice foreman and on December 1, 1923, he was advanced to section foreman, holding that position until his recent promotion to track supervisor.

Harvey Allen Harnish, whose promotion to roadmaster on the Colorado & Southern, with headquarters at Trinidad, Colo., was announced in the September issue, was born at Marion, Kan., on August 26, 1899, and entered railway service as a section laborer on the Northern division of the C. & S. in September, 1921. In July, 1922, he was promoted to section foreman and in April, 1936, he was advanced to track supervisor, the position he held at the time of his recent promotion.

Isom C. Eads, whose retirement as track supervisor on the Louisville & Nashville at Corbin, Ky., was announced in the September issue, was born on February 28, 1874, and entered railway service in 1892, as a section laborer on the L. & N. He was promoted to section foreman in 1899, and for a short time in 1907, he served as a track supervisor at Four Mile, Ky. In 1917, he was again promoted to track supervisor at Pineville, Ky., and was later transferred to Corbin, where he was located until his retirement.

Frank Aikman, Jr., whose promotion to supervisor of track on the Pennsylvania at Carrothers, Ohio, was announced in the September issue, was born in Brooklyn, N.Y., on May 27, 1910, and graduated from Lafayette College in 1932. He entered railway service on April 1, 1934, as an engineering apprentice and later became an assistant in the engineering corps, serving at Jersey City, N.J., New Brunswick, N.J., Trenton, N.J., and Hicksville, N.Y. On January 1, 1936, he was promoted to assistant supervisor of track at Harrington, Del., later being transferred to Wilmington, Del., where he was located at the time of his recent promotion.

J. F. Piper, assistant supervisor of track on the Middle division of the Pennsylvania, has been promoted to supervisor of track, with headquarters at Akron, Ohio, succeeding **A. B. Lewis,** who has been transferred to Piqua, Ohio, relieving **R. W. Grigg,** who has been transferred to New Brunswick, N.J., replacing **A. J. Greenough,** whose promotion to division engineer, with headquarters at Columbus, Ohio, is announced elsewhere in these

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columns. **H. M. Curtiss,** assistant on the engineering corps, has been appointed assistant supervisor of track on the Middle division, succeeding Mr. Piper.

Mr. Piper was born at Pittsburgh, Pa. on August 13, 1910, and attended Ohio State University. He entered railway service in April, 1934, as an assistant on the engineering corps of the Pennsylvania at Trafford, Pa., and was later transferred to Canton, Ohio, and Cleveland. In February, 1936, he was promoted to assistant supervisor of track at Jamesburg, N. J., and in October, 1936, he was transfered to the Middle division, with headquarters at Huntingdon, Pa.

George M. Rowe, whose promotion to roadmaster on the Southern Pacific, with headquarters at Los Angeles, Cal., was announced in the October issue of *Railway Engineering and Maintenance*, was born at San Leandro, Cal., on March 3, 1903, and attended Redlands University. He entered railway service on October 5, 1921, as a rodman in the engineering department of the Southern Pacific and on January 1, 1923, he was appointed an estimator. On November 7, 1924, he was promoted to assistant engineer and on October 1, 1933, he was appointed chief inspector on the construction of the new Los Angeles Union Station, the position he held at the time of his recent promotion.

M. A. Youngblood, track supervisor on the Illinois Central at Greenville, Miss., has been transferred to Tutwiler, Miss., succeeding **Marshall Henry Maynor,** who retired on September 1. **J. M. Jackson,** track supervisor at Durant, Miss., has been transferred to Greenville, replacing Mr. Youngblood.

Mr. Maynor was born on November 9, 1871, and entered railway service as a section laborer on the Illinois Central at Crystal Springs, Miss., in July, 1894. In April, 1895, he was promoted to extra gang and section foreman on the Louisiana division, and in April, 1914, he was promoted to track supervisor on the Greenville division. Mr. Maynor was transferred to the Memphis division, with headquarters at Tutwiler in June, 1933.

Ambrose W. Hyland, whose promotion to roadmaster on the Chicago & North Western, with headquarters at Norfolk, Neb., was announced in the October issue, was born at Ashland, Wis., on February 25, 1897, and entered railway service on May 5, 1914, as a weighmaster on the North Western at Ashland. In 1918 and 1919 he served in the U. S. Army in France, returning to the North Western in the latter year as a switchman. On July 26, 1929, he was appointed assistant general foreman for the engineering department on the Proviso Yard Improvements near Chicago, and in January, 1930, he was promoted to general foreman on track elevation work at Kenosha, Wis. In December, 1931, Mr. Hyland was appointed inspector on the Kenosha track elevation, the position he held until his recent promotion.

George Baylor, assistant supervisor of track on the Pennsylvania, with headquarters at New York, has been promoted to supervisor of track, with headquarters at Crestline, Ohio, succeeding **Philip O'Connor,** who has retired. **N. L. Fleckenstine,** assistant supervisor of track, with headquarters at Rochester, Pa., has been transferred to New York to succeed Mr. Baylor.

Mr. Baylor was born in Augusta County, Va. on September 30, 1910, and graduated in civil engineering from the Virginia Military Institute in 1933. He entered railway service on April 23, 1934, as an assistant on the engineering corps of the Pennsylvania at New Castle, Pa., and was later transferred successively to Johnstown, Pa., Mansfield, Ohio and Niles. On January 1, 1936, he was promoted to assistant supervisor of track at Enola, Pa., and on May 15, 1936, he was transferred to New York. Mr. Baylor was recently appointed acting supervisor of track on the New York division, the position he held at the time of his promotion, which was effective October 1.

J. W. Weaver, general foreman on the Erie at Kent, Ohio, has been promoted to track supervisor, with headquarters at Marion, Ohio, succeeding **A. J. Bernard,** who is absent due to illness.

Mr. Weaver was born at Sterling, Ohio on December 12, 1901, and entered railway service in May, 1919, as a timekeeper on the Baltimore & Ohio. In April, 1920, he went with the Erie as a trackman and in November of that year he was promoted to assistant foreman. In April, 1922, he was appointed supervisor's clerk and in October, 1923, he was appointed maintenance of way clerk, later being reappointed supervisor's clerk. Mr. Weaver was appointed a section foreman in June, 1929, and in January, 1934, he was promoted to general foreman.

E. L. Caldwell, section foreman on the Illinois Central, has been promoted to supervisor of track, with headquarters at Harriston, Miss., relieving **H. R. Davis,** whose promotion to division engineer, with headquarters at Vicksburg, Miss., is announced elsewhere in these columns.

Mr. Caldwell was born in Attala County, Miss., on July 17, 1894, and entered railway service on March 1, 1916, as an extra gang laborer on the Illinois Central. On September 1, 1916, he was promoted to section foreman. He was advanced to track supervisor on the Yazoo & Mississippi Valley (part of the Illinois Central) with headquarters at Shreveport, La., on September 1, 1926, and was later transferred to Monroe, La. Mr. Caldwell was appointed a section foreman on May 1, 1933, and remained in that position until his recent promotion, which was effective October 1.

Charles Pfeifer, supervisor of track on the Elgin, Joliet & Eastern, with headquarters at Joliet, Ill., has been promoted to roadmaster, with the same headquarters, succeeding **A. E. Muschott,** who has retired because of ill health. **S. H. Shepley** has been appointed track supervisor at Joliet, replacing Mr. Pfeifer.

Mr. Pfeifer was born in Richton Township, Cook County, Ill., on April 26, 1879, and entered railway service in April, 1897, as a track laborer on the E. J. & E., later becoming an assistant foreman. On June 18, 1902, he left railway service but returned to the E. J. & E. on March 17, 1905, as a track foreman and served in this capacity and as an extra gang foreman until February 15, 1935, when he was promoted to track supervisor, with headquarters at Joliet, the position he held until his recent promotion.

Mr. Shepley was born at Minneapolis, Minn., on March 31, 1906, and graduated in civil engineering from the University of Minnesota in 1929. He entered railway service on August 15, 1929, as a draftsman in the office of the bridge engineer of the Northern Pacific at St. Paul, Minn., and in November, 1930, he went with the Elgin, Joliet & Eastern as a draftsman at Joliet. From June, 1932, to February, 1937, he held various positions with the Minnesota State Highway Department, but returned to his former position with the E. J. & E. on the later date, which position he held until his recent promotion to supervisor of track, which was effective on September 16.

Mr. Muschott was born in Sweden on January 23, 1871, and entered railway service on July 5, 1887 as a section laborer on the Flint & Pere Marquette (now the Pere Marquette) at Lake Station, Mich. On January 22, 1892, he was promoted to section foreman and on November 16, 1900, he was advanced to roadmaster. On May 1, 1903, he went with the Chicago, Rock Island & Pacific as a roadmaster at McFarland, Kan., and on September 16, 1905, he was transferred to Atlantic, Iowa. Mr. Muschott was transferred to Joliet on February 2, 1908, and on October 21, 1913, he went with the E. J. & E. as a roadmaster, holding that position until his retirement.

Bridge and Building

William A. Barnes has been appointed bridge supervisor of the Atlanta & Saint Andrews Bay, with headquarters at Dothan, Ala.

J. B. McDowell has been appointed acting bridge and building master of the Calgary division of the Canadian Pacific, with headquarters at Calgary, Alta., succeeding **H. A. Maclean,** who has been granted an indefinite leave of absence for military service.

D. W. Isaacs, master carpenter on the Chicago, Rock Island & Pacific at El Reno, Okla., has been transferred to Des Moines, Iowa, succeeding **Charles H. Gaylord,** who has been assigned to other duties, and **L. F. Cooper,** bridge foreman on the Oklahoma division, has been promoted to master carpenter at El Reno, replacing Mr. Isaacs.

Peter Aagaard, superintendent of buildings of the Illinois Central, with headquarters at Chicago, retired on October 1. Mr. Aagaard was born at Aalborg, Denmark, on September 9, 1869, and received his higher education at a technical school in Aalborg. He entered railway service in 1896 as a carpenter on the Illinois Central, and three years later he was promoted to general foreman of bridges and buildings of the Chicago Terminal. Mr. Aagaard was advanced to supervisor of bridges and buildings of the Chicago division in 1907 and to general inspector

of buildings for the system, with headquarters at Chicago, in 1913. He was appointed superintendent of buildings, with headquarters in Chicago, in 1928.

R. DeJaiffe, assistant master carpenter of the Philadelphia Terminal division of the Pennsylvania, has been promoted to master carpenter of the Atlantic division and of the Pennsylvania-Reading Seashore Lines, with headquarters at Camden, N.J., succeeding **W. R. Taggart,** who has been transferred to the Long Island Railroad, with headquarters at Jamaica, L.I., N.Y. Mr. Taggart replaces **W. R. Ganser,** who has been transferred to the New York division of the Pennsylvania, with headquarters at Jersey City, N.J., where he succeeds **B. F. Stidfole, Jr.,** retired.

Obituary

T. R. Rutledge, assistant to the chief engineer of the Union Pacific, died at Omaha on October 4 of a brief illness following an asthmatic attack.

Richard C. Kendall, who retired in October, 1937, as master carpenter on the Chicago & Western Indiana, with headquarters at Chicago, died in that city on October 14.

C. J. Harrington, division engineer on the Illinois Central, with headquarters at Champaign, Ill., died suddenly at that point on September 29.

H. M. Hockman, division engineer of the Clover Leaf district of the New York, Chicago & St. Louis, (Nickel Plate) with headquarters at Frankfort, Ind., died on September 4.

Frank A. Keene, assistant supervisor of bridges and buildings on the New York, New Haven & Hartford, with headquarters at Stamford, Conn., died on October 12, at the age of 69 years.

Vivian T. Douglas, who retired after 58 years of service in the spring of 1939 as supervisor of track on the Chesapeake & Ohio, at Richmond, Va., died at that point on August 22, at the age of 72.

E. W. Boots, who retired in 1931 as engineer maintenance of way of the Pittsburgh & Lake Erie, died on September 16 at his home in Pittsburgh, Pa. Mr. Boots was born on June 7, 1870, and attended Geneva College. He entered railway service in 1889 as chainman with an engineering corps on the Pittsburgh & Lake Erie, and served consecutively as rodman, levelman and transitman until 1892 when he became assistant engineer. Mr. Boots was appointed engineer maintenance of way in April, 1918, the position he held until his retirement in 1931.

Frank J. Welch, who retired in November, 1937, as assistant chief carpenter on the Coast division of the Chicago, Milwaukee, St. Paul & Pacific, died in Seattle, Wash., on August 25. Mr. Welch began railway service with the Milwaukee in 1897 as an extra gang timekeeper on the Iowa and Dakota division, and in 1904 he was transferred to the bridge and building department, where he was successively bridge carpenter, pile inspector and bridge inspector. In 1917, he was promoted to chief carpenter of the Coast division, with headquarters at Tacoma, Wash., and remained there until 1929, when he was transferred to Green Bay, Wis. In 1930 following the consolidation of chief carpenter's territories, Mr. Welch returned to the Coast division as assistant chief carpenter, where he remained until his retirement in November, 1937.

Charles W. Johns, chief engineer of the Chesapeake & Ohio at Richmond, Va., whose death on September 16 was reported in the October issue, was born on December 28, 1875, at Farmville, Va. He entered railway service on September 1, 1899, as instrumentman on the Chesapeake & Ohio and then served as assistant engineer on construction. In August, 1903, he became assistant engineer in the maintenance department at Hinton, W. Va., and in December, 1904, was appointed assistant division engineer there. Mr. Johns became division engineer at Hinton in May, 1906, and two months later was appointed assistant engineer maintenance

Charles W. Johns

of way, with the same headquarters. From May, 1910, until February, 1914, Mr. Johns served as engineer maintenance of way at Huntington, W. Va., and from the later date until August, 1920, as engineer, branch lines at Richmond, Va. In August, 1920, he was appointed engineer of construction and became chief engineer in January, 1923.

B. A. Terhune, roadmaster on the Chicago, Burlington & Quincy, with headquarters at Craig, Mo., died on October 8 as the result of injuries received in a train collision at Napier, Mo., on October 2. Mr. Terhune was born at Woodburn, Iowa, on February 8, 1897, and entered railway service in June, 1912, as a water boy and track laborer at Lincoln, Neb. In September, 1916, he was promoted to assistant foreman at Omaha, Neb. From May, 1918, until April, 1919, he served in the U. S. Army, returning to the Burlington on the latter date as an extra gang foreman on the Lincoln division. In December, 1919, he was appointed yard foreman at Omaha and in September, 1921, he was advanced to assistant roadmaster on the Ottumwa division. Mr. Terhune was promoted to roadmaster, with headquarters at Osceola, Iowa, on October 1, 1923, and a year later he was transferred to Centerville, Iowa. On March 1, 1926, he was transferred to Brookfield, Mo., and two years later to Craig, Mo.

Supply Trade News

Personal

B. H. Lawrence, chief engineer, has been elected vice-president in charge of engineering, **United States Steel Corporation of Delaware,** and a member of its executive committee and board of directors.

D. S. Betcone, from 1935 to 1937 president of **Steel Buildings, Inc.,** has been appointed midwestern field representative of the **Douglas Fir Plywood Association,** with headquarters at Chicago.

Trade Publications

Buda-Hubron Earth Drill—The Buda Company, Harvey, Ill., has prepared an eight-page bulletin, No. 868A, describing the Buda-Hubron earth drill, which is a mechanical drill for digging cylindrical holes up to 42 in. in diameter and to depths of 50 ft., in earth, shale, hardpan, frozen ground or other similar material. The bulletin contains many illustrations showing the wide variety of uses, such as pole line construction, foundation work, pre-boring for piles, blasting operations, pipe line work and track drainage work.

Subdrainage—The Toncan Culvert Manufacturers' Association, Cleveland, Ohio, has issued a 34-page profusely-illustrated booklet bearing this title which deals at length with the various types of subdrainage problems that are encountered today. In different chapters, the booklet discusses the principals underlying the need for subdrainage, the effect of subdrainage on ground water, methods of constructing subdrains, types of subdrainage installations and the requirements of subdrainage pipe. The different types of Toncan pipe that are suitable for subdrainage purposes are described, suggested specifications for this type of pipe are given and a number of tables containing equivalents and other information useful in the design of subdrainage installations are included.

Railroad and Industrial Cars—The principal products of the Pressed Steel Car Company (Koppel division), Pittsburgh, Pa., are described in this company's 16-page Bulletin No. 71 entitled "Dependable Industrial Railway Cars for Service Everywhere." Included in this bulletin are descriptions and illustrations of: dump cars, and platform cars of many sizes and types; cars for special industrial and railroad services, such as heavy-duty tram cars, quarry cars, ladle cars, hopper cars and transfer cars; the standard types of box cars, gondolas, cattle, tank, flat and sugar cane cars; accessories and supplementary equipment such as buckets, skips of several types, standard safety type couplers, automatic couplers, and link-pin couplers; trucks of the arch bar and of the cast steel types; typical installations of Timken and Hyatt roller bearings on standard railway cars; journal boxes and wheels, and sections of industrial track, switches, crossings, steel ties and turntables.

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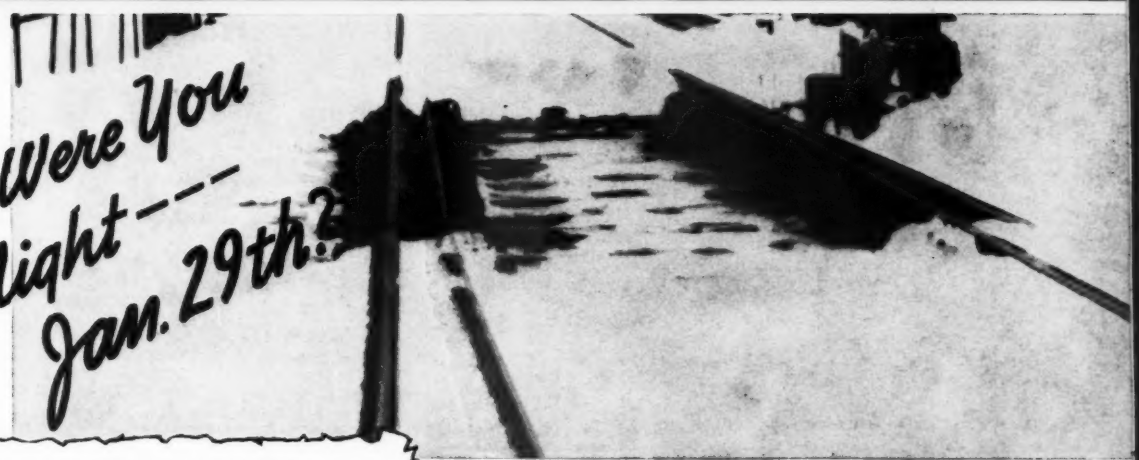

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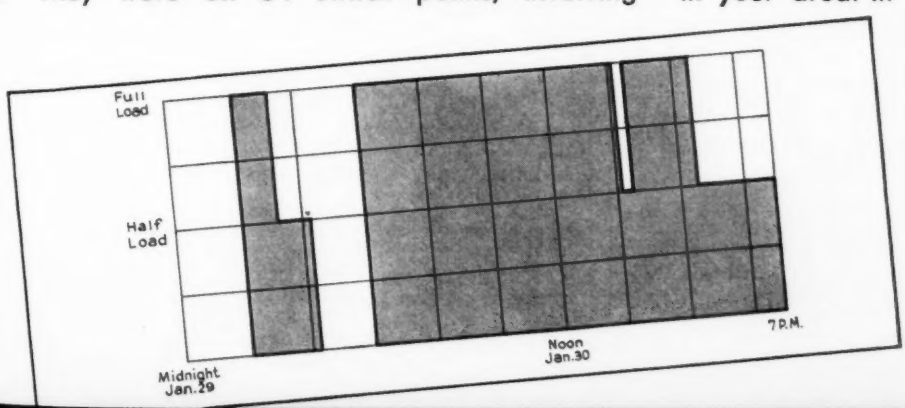

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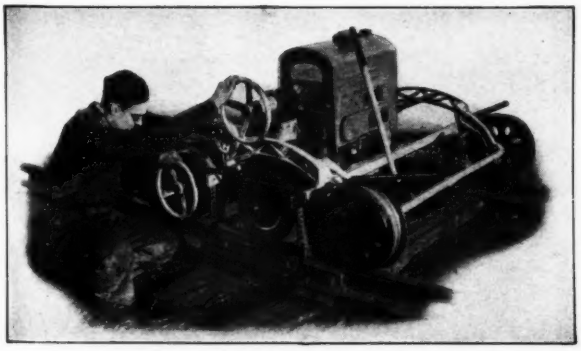

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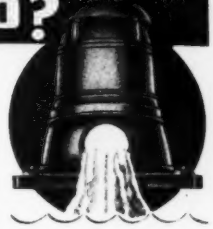

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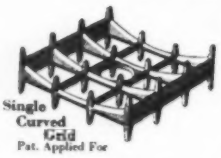

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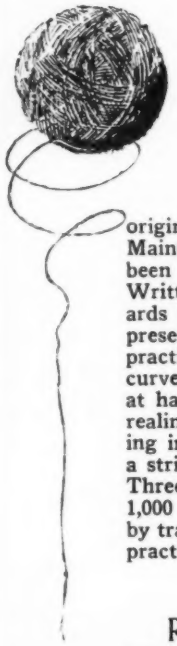

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Of RAILWAY ENGINEERING & MAINTENANCE published monthly at Chicago, Illinois, for October 1, 1939.

State of Illinois } ss.
County of Cook }

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Elmer T. Howson, who, having been duly sworn according to law, deposes and says that he is the editor of the RAILWAY ENGINEERING & MAINTENANCE and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit:

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Sworn to and subscribed before me this 28th day of September, 1939.

ANNE A. BOYD.
(SEAL) (My commission expires Dec. 10, 1939.)

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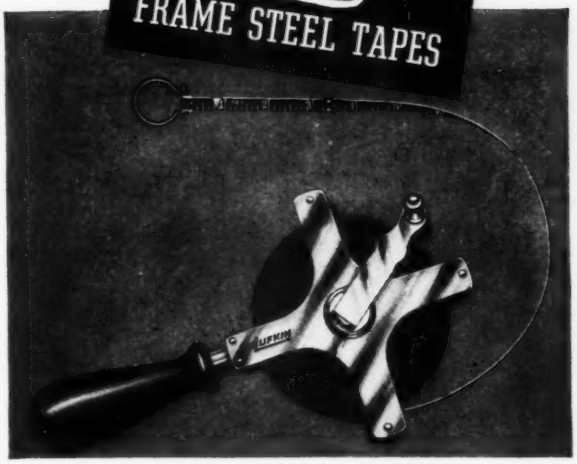

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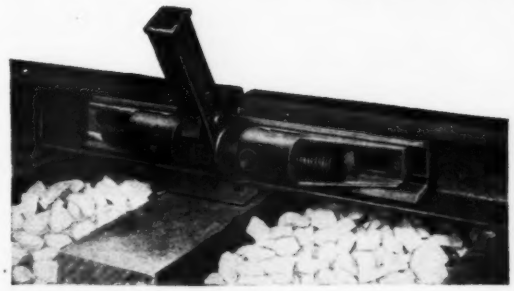

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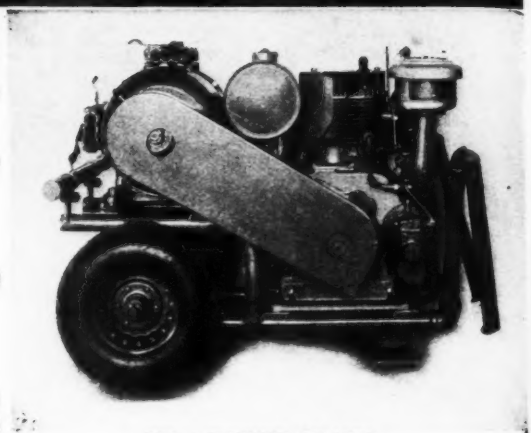

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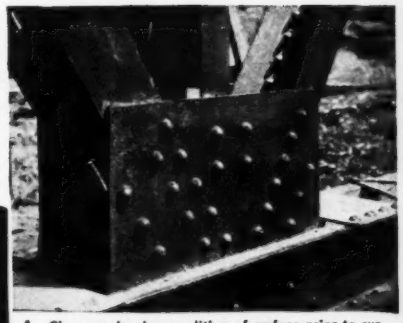
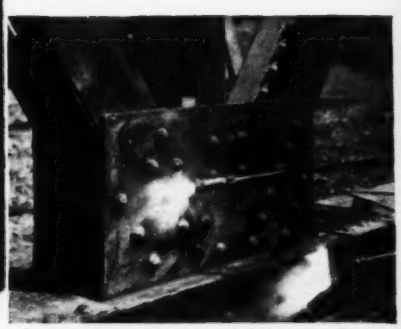


1. Close-up showing condition of surface prior to surface conditioning.



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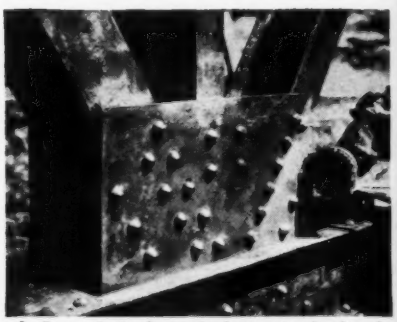
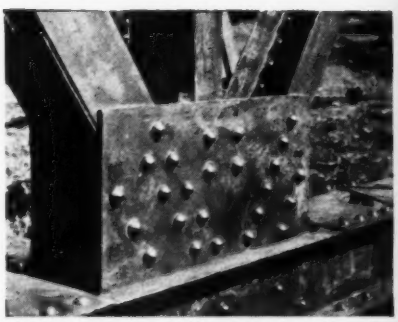


3. Power wire brush removing loose rust and scale and cockled paint.



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